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THE
RURAL CYCLOPEDIA,
OR A
GENERAL DICTIONARY OF AGRICULTURE,
AND OF THE
ARTS, SCIENCES, INSTRUMENTS, AND PRACTICE,
NECESSARY TO THE
FARMER, STOCKFARMER, GARDENER,
FORESTER, LANDSTEWARD,
FARRIER, &c.

EDITED BY THE
REV. JOHN M. WILSON.

VOLUME I.

A—C.



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P R E F A C E.

THE RURAL CYCLOPEDIA communicates a thorough knowledge of farming, a general knowledge of gardening, and a very considerable knowledge of the natural sciences, and of general country affairs. It presents to farmers a digest of all agricultural literature; and, at the same time, offers to gardeners, foresters, land-stewards, and other well-informed classes of the rural community, a larger amount of rich and well-timed information than can be found in any one of the numerous works which have been expressly written for their benefit. About one-fifth of it is reprint of selected articles or portions of articles in the Edinburgh Encyclopædia, the Conversations Lexicon, Booth and Boyes' Encyclopædia of Chemistry, Millington's Engineering, and some other very expensive publications; and all the remainder is original compilation by the Editor,—remotely from the stores of twenty-five years' observation and general reading, and immediately from a library collected for the purpose, and containing a mass of parliamentary papers, the principal agricultural and horticultural periodicals, many reports and transactions of public bodies, and all the best dissertational and systematic treatises on the cultivation of the soil, practical and scientific, ancient and modern, foreign and domestic. All the reprint has been carefully revised; all the compilation has been as thoroughly digested and as laboriously composed as if it had wholly consisted of original matter; and such articles as were thought to incur any risk of either error or deficiency of statement have been submitted to the revision of very eminent and well-known practical men. The work, as a whole, will be found powerfully adapted to the existing condition of the arts of culture, letting in upon them a flood of light from the investigations of science, and yet accurately and searchingly treating them in a homely and business-like manner.

All the practices, implements, and buildings of the farm, the dairy, and the garden, both as they are and as they ought to be, are thoroughly discussed. The agricultural usages of different districts and countries, and occasionally those of different ages, are compared. The management of stock-farms, the breeding, improving, and rearing of sheep and cattle, and the right feeding and sanatory treatment of all the domestic animals, are fully stated. Most beasts, birds, and fishes which are serviceable to man, whether in Britain or in other lands, are described;

and all birds, vermin, worms, and insects which are mischievous or annoying to the farmer or the gardener are minutely noticed. All plants in cultivation on the farm, most plants in cultivation in the garden, all weeds, all grasses, and multitudes of useful and ornamental plants quite recently discovered or but little known, are described proportionately to their several importance, and with ample reference to their habits, their value, and their proper treatment. The physiology and the diseases of both animals and plants are abundantly explained. Agricultural chemistry, down to its most recent discoveries, is fully taught; and as much general chemistry as seems desirable for illustrating it is added. Soils, subsoils, rocks, mineral manures, and mineral transmutations, are exhibited in the light of at once geology, analysis, and practical adaptation. Legal knowledge, in all matters which can affect the landlord and the tenant, or the master and the servant, is communicated; and information on carpentry, masonry, smithy-work, and other departments of art occasionally required on the farm and in the garden, is somewhat freely given. In short, the drift of the *RURAL CYCLOPEDIA* is to supply farmers, gardeners, foresters, and similar classes with all the information they can want for their several professions, or to place before them, in a manner of the easiest access, and in a state of perfect readiness for their use, a larger and wealthier system of professional knowledge than any but the most highly favoured could obtain from prolonged and anxious consultation of both men and books.

This work is, thus, much more comprehensive than any of the numerous ones of its class which have yet appeared. It condenses out of the reports and the periodicals masses of important agricultural matter at which they scarcely glance; it discusses many subjects of farming and gardening which they either pass over or very slightly touch; it introduces entire departments of valuable knowledge which they altogether exclude; it contains, in quite a practical form, a considerable body of useful scientific matter which they seem to regard as totally beyond their sphere; it greatly excels most, and will bear comparison with the best, in both the amplitude and the minuteness of its practical details; and, with one partial exception, it stands alone, as a mainly and professedly agricultural work, in conjointly addressing farmers, gardeners, and foresters,—in making the arts of these classes illustrate one another,—and in attempting to be a general instructor of the community upon rural affairs. These statements are made, not invidiously, nor with the slightest intention of detracting from the great and many excellencies of Mill, Donaldson, Dickson, Young, Sinclair, Loudon, Stephens, Johnson, Low, Sproule, Doyle, Rham, and others, but solely for the purpose of pointing out the chief grounds on which the present work professes to go in advance of its predecessors, and to supply a great and important desideratum in rural literature.

The Editor originally intended to write a long General Introduction, sketching the history of the arts of culture, connecting all the principal subjects of his Work into a series, and instructing young learners as to the proper order of studying respectively agriculture, horticulture, arboriculture, and farriery; but he has, in a great degree, anticipated his intention, and disposed of the materials for it in a better way, by regularly giving historical notices in all the articles which required

or admitted them,—by furnishing separate systematic outlines of each of the great departments of art, and of each of the connected or ancillary sciences,—and by everywhere making such copious references from article to article as must enable even the most ill-informed readers to pass with ease and efficiency to all the parts of a subject or a system. Yet a few hints for guiding inexperienced persons to the most profitable use of the abundant matter laid before them in the *RURAL CYCLOPEDIA* may be serviceable, and shall here be given.

The best course of preparatory training for young farmers is detailed in the article *AGRICULTURAL EDUCATION*. Some excellent institutions for aiding this course are mentioned in the article *AGRICULTURAL SCHOOLS*; and another recent one of high value, which did not become known to the Editor till after that article was in type, is Cirencester College in England. Some advantages which may be enjoyed by young practical gardeners are noticed in the article *GARDENER*. The proper course of training and reading for farriery are suggested in the articles *VETERINARY MEDICINE* and *HIPPOPATHOLOGY*. A general view of the nature of landed property is given in the article *LAND (PROPERTY IN)*; of the tenant occupancy of land, in the articles *LEASE*, *TENANT-RIGHT*, and *RENT*; of the measuring, applotting, and enclosing of lands, in the articles *LAND-SURVEYING*, *MENSURATION*, *LEVELLING*, and *ENCLOSURE*; of georgy, or the reclaiming and improving of land, in the articles *WASTE LAND*, *IMPROVEMENT OF LAND*, *HEATHS*, *BOG*, *DRAINING*, and *PARING and BURNING*; of arable husbandry, in the articles *TILLAGE*, *PLOUGHING*, *PULVERIZATION*, *FALLOW*, and *DRILL-HUSBANDRY*; of mixed husbandry, in the articles *FARM*, *SOIL*, and *ROTATION OF CROPS*; of stock farming, in the articles *LIVE STOCK*, *GRASS-LANDS*, *BREEDING*, and *FEEDING OF ANIMALS*; of dairy-farming, in the articles *DAIRY*, *COW*, *MILK*, *BUTTER*, and *CHEESE*; of cottage husbandry or small farming, in the articles *COTTAGE-HUSBANDRY*, *ALLOTMENT SYSTEM*, and *SPADE-HUSBANDRY*; of gardening, in its various and widely different departments, from the management of the kitchen plot to the cultivation of the rarest exotics, in the articles *COTTAGE-GARDENING*, *GARDEN*, *HORTICULTURE*, and *HOTHOUSE*; of the successional culture of the farm and the garden throughout the year, or the order of operations in them from month to month, in the article *CALENDAR*; of arboriculture, in the articles *PLANTATION*, *PLANTING*, *TREE*, and *COPPICE*; and of the forming and decorating of parks and pleasure-grounds, in the article *LANDSCAPE-GARDENING*. In most cases, too, these general articles contain a profusion of references to others on related or subordinate subjects; so that they will readily direct an inquirer in any one department round the whole circle of topics which he wishes or needs to know.

The systematic study of agriculture may be most successfully prosecuted in the order of soils, manures, implements, buildings and enclosures, general economy, georgical improvements, tillage, mutual adaptation of soils and crops, cultivation of the cereal grasses, cultivation of green crops, cultivation of miscellaneous field plants, management of grass lands, and the management of livestock and of animal produce. The student will find the general subject of soils discussed in the article *SOIL*; the formation of several extensive, specific soils, in the articles *ALLUVIUM*, *DILUVIUM*, *CARSE*, and *BOG*; the principal classes of soils, in the articles

SAND, CLAY, CHALK, and LOAM; the chief constituents of soils, in the articles EARTH, HUMUS, MOULD, SALTS, and ALKALIES; the varieties and indications of sterility in soils, in the article BARREN SOILS; and the methods of improving soils, in all articles on manure, georgy, and tillage. He may study the general subject of manures, in the article MANURE; the manures of the farmery, in the articles FARM-YARD MANURE, LIQUID MANURE, and URINE; mixed manures, obtained elsewhere than on the farmery, in the articles COMPOST, POLICE MANURE, SEWERAGE, and SEA-OOZE; the principal animal manures, in the articles ANIMAL MANURE, EXCREMENT, BONE-MANURE, and GUANO; the principal vegetable ones, in the articles GREEN-MANURE, SEA-WRACK, and PEAT; and the principal inorganic ones, in the articles ASHES, LIME, GYPSUM, together with many others referred to in the article MANURE. He will become acquainted with the general subject of implements from the article IMPLEMENTS (AGRICULTURAL); with the principal implements of georgy and tillage, from the articles PLOUGH, GRUBBER, HARROW, and ROLLER; with those for sowing, from the article SOWING-MACHINES; with those for hoeing, in the articles HOE and HORSE-HOE; with those for hay-making and harvest-work, in the articles SCYTHE, SICKLE, REAPING-MACHINE, RAKE, HAY-RAKE, and HAY-TEDDING MACHINE; with those of the barn, in the articles BARN-MANAGEMENT, STEAM-ENGINE, THRASHING-MACHINE, WINNOWING-MACHINE, HUMMELLER, and SIEVE; with those for preparing cattle-food, in the articles CHAFF-CUTTER, TURNIP-SLICER, OIL-CAKE-BREAKER, BRUISING CORN, and STEAMING-APPARATUS; with those of the dairy, in the articles LACTOMETER, CHURN, and CHEESE-PRESS; with those of conveyance, in the articles BARROW, CART, LIQUID-MANURE-CART, TUMBREL, WAGGON, and WHEEL-CARRIAGE; and with the chief miscellaneous implements of the farm, in the articles WEIGHING-MACHINE, TILE, ODOMETER, PROBANG, HORDEOMETER, FORK, LADDER, SPADE, and many others. The student will dispose of buildings in the articles FARM-BUILDINGS, FOUNDATIONS, MASONRY, ASHLAR-WORK, CARPENTERS' WORK, BRICK-MAKING, BRICK-WORK, WALL, COTTAGE, BARN, STABLE, COW-HOUSE, OX-STALLS, and SHEEP-STELL; and of enclosures in the articles FENCE, HEDGE, PALING, GATE, HURDLE, EMBANKMENT, and SHELTER. He will find one branch of general economy discussed in the articles LEASE, RENT, and TAXES; another in the article FARM-ACCOUNTS; another in the articles CONTRACT, CONVEYANCE, and many more on the legal affairs of property; another in the articles ROAD, CANAL, and CARRIER; another in the articles MARKET, CORN-MARKET, and FAIR; another in the articles AGENT, FARM-SERVANTS, FARM-LABOURERS, PLOUGHMEN, and SHEPHERD; another in the articles WEED and VERMIN; and another in the articles SEED and AGRICULTURAL SEEDS. He may pursue the subject of georgical improvements in many gradations and departments, from the coarsest reclamation of waste land to the most refined application of chemical manures, through the intermediate or concomitant or occasional stages of draining, paring, burning, levelling, subsoil-ploughing, textural manuring, liming, fallowing, warping, irrigating, surface-manuring, special cropping, and the instituting of a regular balance account between the substances abstracted by crops and the substances restored by manures; and he will be mainly aided by the articles IMPROVEMENT OF LAND, DRAINING, PARING AND BURNING, SUBSOIL-PLOUGHING, MANURE,

LIME, WARPING, IRRIGATION, and others to which references are made in these. He may acquaint himself with the chief simple operations of tillage, in a general way, from the articles PLOUGHING, HARROW, GRUBBER, ROLLING, HOEING, and SPADE-HUSBANDRY; with the chief complex operations of tillage, in a general way, from the articles FALLOW and PULVERIZATION; with all the operations of after-culture, in their many diversities, from the articles on all the field-crops which require their use; and with the operations of sowing, haymaking, and harvesting, in a general way, in the articles SOWING, HAYMAKING, REAPING, and HARVEST. He will see far into the intricate but important subject of the mutual adaptation of soils and crops, with the aid of the articles SOIL, ROTATION OF CROPS, ALTITUDE, and CLIMATE; yet, before he can sufficiently discern it, he must peruse the sections on suitable soils in the articles on all the field-crops. He will understand the cultivation of the cereal grasses, or of plants which are useful principally for their farinaceous seeds, and subordinately for their straw or haulm, from the articles WHEAT, RYE, BARLEY, OAT, MAIZE, RICE, CANADA RICE, MILLET, INDIAN MILLET, BUCKWHEAT, and GOOSEFOOT; the diseases to which cereal crops are subject, from the articles ACCIDENTS, BLIGHT, MILDEW, SMUT, *ÆCIDIUM*, RUST, ERGOT, and WHEAT FLY; the cultivation of the leguminous seed crops, or of sarcolobous leguminosæ which are useful principally for their seeds or pods, and subordinately for their haulm, from the articles BEAN, PEA, KIDNEY-BEAN, DOLICHOS, LENTIL, TARE, and VETCH; the cultivation of the herbage and forage leguminous plants, or of leguminosæ which are useful mainly in the same way as the forage grasses, from the articles CLOVER, LUCERN, SAINFOIN, MELILOT, GOATS' RUE, KIDNEY-VETCH, MILK-VETCH, BIRD'S-FOOT-TREFOIL, CROWN-VETCH, HEDYSARUM, LATHYRUS, LUPINE, MEDICK, FURZE, CYTISUS, GENISTA, and BROOM; the cultivation of the chief esculent root plants, from the articles POTATO, ARTICHOKE (JERUSALEM), ARACACHA, LILY (EATABLE ROOTED), WOOD-SORREL, BIND-WEED, YAM, BATTATAS, PSORALEA, TURNIP, BEET, MANGEL-WURZEL, CYPERUS, INDIAN CRESS, CARROT, and PARSNIP; the cultivation of the principal herbage and forage grasses from the articles GRASSES, RYEGRASS, FIORIN, TUSSAC-GRASS, AGROSTIS, DACTYLIS, POA, PHLEUM, and many others referred to in the article GRASSES; the cultivation of the principal herbaceous and forage plants, belonging to other natural orders than the legumes and the grasses, from the articles CABBAGE, BORECOLE, RAPE, COLE, KOHL-RABI, BUNIAS, SUCCORY, LETTUCE, BURNET, COMFREY, MILFOIL, DAY-LILY, MUSTARD, PARSLEY, PLANTAIN, SPURREY, LAGENARIA, PRANGOS, SPIRÆA, and GOURD; the cultivation of fibre plants and oil-plants, from the articles FLAX, HEMP, HOP, NETTLE, FLAX-LILY, COTTON, DOG'S-BANE, SWALLOW-WORT, MARSHMALLOW, LAVATERA, SIDA, BROOM, LINSEED, OIL-CAKE, RAPE, MUSTARD, RADISH, CAMELINA, ROCKET, SUNFLOWER, EUPHORBIA, ARACHIS, MADIA, and the articles on the plants which yield the essential oils noticed in the article OIL; and the cultivation of the principal field plants which are used for dyeing or for other purposes of art, from the articles WOAD, MADDER, BEDSTRAW, DYER'S WEED, WOODRUFF, SUMACH, CARTHAMUS, SAFFRON, BUCKTHORN, CUDBEAR, COREOPSIS, XANTHIUM, TEASEL, SALTWORT, TOBACCO, CLUB-RUSH, EQUISETUM, CARAWAY, CORIANDER, CUMIN, HORSE-RADISH, LIQUORICE,

SOAPWORT, LARKSPUR, and PHYTOLACCA. The student will learn the general management of grass lands, from the article GRASS LANDS; the alternations of grass and tillage, from the articles ALTERNATE HUSBANDRY and LEA; the management of permanent pastures, from the articles PASTURE, PASTORAL FARM, DOWNS, and HEATHS; the management of permanent meadows, from the articles MEADOW and IRRIGATION; and the management of the cut produce of meadows and alternate grass lands, in the articles AFTERGRASS, FODDER, and HAY. He will understand the selecting, proportioning, and general managing of the animals of the farm, from the article LIVE-STOCK; the rearing of farm animals, from the articles PARTURITION, BREEDING, and CROSSING; the general feeding of farm animals, from the articles FEEDING OF ANIMALS, FATTENING OF ANIMALS, FOOD OF ANIMALS, and others referred to in these; the sanatory treatment of farm animals, from the articles VENTILATION and EXERCISE, and from the numerous ones mentioned in the article DISEASES OF ANIMALS; the particular management of the several species of farm animals, from the articles HORSE, ASS, CATTLE, SHEEP, ALPACA, HOG, GOAT, and POULTRY; and the management of the principal departments of animal produce, from the articles MEAT, CALF, LAMB, BACON, BRAWN, BUTTER, CHEESE, EGG, and WOOL.

The studies of the gardener, the forester, the farrier, the land-steward, and other rural operators, comprise a vastly less ramified and less intricate system than those of the farmer, and can be easily prosecuted throughout the RURAL CYCLOPEDIA without other specification of articles than will be spontaneously suggested by every inquirer's own wants. Yet the gardener will do well to go through the same initiatory course as the farmer on the subjects of soils, manures, and buildings; and he and the forester and the farrier will all secure clearness and force in the result of their inquiries, by acquainting themselves successively with implements, operations, and ulterior objects. The gardener, therefore, after disposing of soils, manures, and buildings, should read the numerous articles which describe the things mentioned in the short article IMPLEMENTS (HORTICULTURAL); he should next examine the articles CUTTING, LAYER, BUDDING, GRAFTING, PRUNING, and all others of the same class; he may next study the articles DROPSY, GANGRENE, HONEY-DEW, APHIS, COCCUS, CATERPILLAR, MOTH, and the many others which treat of the diseases of plants and of the insects which cause them; and he may then study in succession the articles on kitchen garden crops, such as ONION, LETTUCE, and ASPARAGUS,—the articles on hardy fruit plants, such as ORCHARD, FRUIT, APPLE-TREE, APRICOT, and STRAWBERRY,—the articles on the principal glories of the shrubbery and the parterre, such as RHODODENDRON, AZALEA, DAHLIA, and VERBENA,—the articles on the chief denizens of glazed structures, whether carpical or floral, such as VINERY, BANANA, PALM, CAMELLIA, PELARGONIUM, PASSION-FLOWER, and ORCHIS,—and the articles on the rarest or most recently discovered beauties of at once the open ground, the greenhouse, and the stove, such as will meet his eye by the score in almost every fifty pages of the RURAL CYCLOPEDIA, and will render this work a source of constant novelty to him for many years. The forester, in a similar way, may study his implements in such articles as AXE and DENDROMETER,—his operations in such as PLANTING, BARKING, and FELLING,—his plagues

and perils in such as **CANKER**, **EXTRAVASATION**, **BOSTRICHIDÆ**, and **SCOLYTUS**,—and his ulterior objects in all the many hundreds which treat of groups of trees, and of the several genera and species; and the farrier may study his implements in such as **BLISTER**, **BALL**, and **ROWEL**, and in all the multitudes on medicinal substances and pharmaceutical preparations,—his operations in such as **BLEEDING**, **LITHOTOMY**, and **TRACHEOTOMY**,—and his ulterior objects in all which treat of the many diseases and casualties to which the domesticated animals are subject.

The most consecutive method, and therefore the easiest and most efficient one, of mastering the scientific matter which the **RURAL CYCLOPEDIA** lays before the various classes of its readers, will be to study it in the order of meteorology, mineralogy, geology, chemistry, electricity, botany, vegetable physiology, zoology, anatomy, animal physiology, and natural philosophy. Meteorology is outlined in the articles **METEOROLOGY** and **WEATHER**, and discussed in the numerous others to which these refer. Mineralogy is outlined in the article **MINERALOGY**, and discussed in hundreds of articles on ores, earths, and other native minerals. Geology is treated formally in the articles **GEOLOGY** and **ORGANIC REMAINS**, and subordinately or incidentally in those which have been specified on the subject of soils, and in multitudes which discuss rocks, minerals, inorganic manures, and georgical operations. Chemistry, in some of its general phases, is discussed in the articles **AFFINITY**, **ATOMIC THEORY**, **ANALYSIS**, **CALORIC**, **EVAPORATION**, **GAS**, **ABSORPTION IN CHEMISTRY**, **OXYGEN**, **HYDROGEN**, **AZOTE**, **CARBON**, **FERMENTATION**, **EREMACAUSIS**, **PUTREFACTION**, and a number of others; in its connexions with pharmacy, or with the purposes of the farrier, it is discussed in such articles as **DISTILLATION**, **SUBLIMATION**, **INFUSION**, **EXTRACT**, **PRECIPITATION**, **TINCTURES**, and **SYRUP**, and in most which treat of medicines; and in its connexions with organic nature and with the pursuits of farming, gardening, and forestry, it is outlined in the articles **ORGANIC CHEMISTRY**, **AGRICULTURAL CHEMISTRY**, and **VEGETABLE CHEMISTRY**, and discussed in such articles as **ALKALIES**, **SALT**, **AMMONIA**, **CARBONATES**, **NITRATES**, **SULPHATES**, **PHOSPHATES**, **SILICA**, **ALUMINA**, and **LIME**, and in almost all upon the various animal, vegetable, mineral, mixed, and special manures. Electricity is treated principally in the articles **ELECTRICITY** and **MAGNET**. Botany is outlined in the article **BOTANY**, and discussed seriatim in the many articles on the parts and organs of plants, such as **ROOT**, **BULB**, **STEM**, **BARK**, **LEAF**, **FLOWER**, **PISTIL**, **STAMENS**, and **FRUIT**, and in those which give summary views of the Jussieuan orders, such as **MALLOW**, **RANUNCULUS**, and **EUPHORBIA**,—the general rule throughout the work being to describe the orders in the articles upon the genera or species which represent them, except in instances where the Jussieuans have named them according to organic characteristics, such as **LEGUMINOUS PLANTS**, **CRUCIFEROUS PLANTS**, **LABIATÆ**, and **FLUVIALES**. Vegetable Physiology is outlined in the article **VEGETABLE PHYSIOLOGY**, and discussed at great length in the numerous articles which are therein named. Zoology is outlined in the articles **ZOOLOGY** and **ANIMAL**, and discussed in most of its chief divisions and prominent topics, in the articles **ORNITHOLOGY**, **FISHES**, **REPTILES**, **INSECTS**, **PARASITES (ANIMAL)**, and **WORMS**, and in all the multitudes which treat of the several quadrupeds, birds, fishes, insects, and creeping things

of Britain. Anatomy is glanced at in the article ANATOMY OF ANIMALS,—outlined, in the case of the chief domesticated animal, in the article HORSE,—and discussed, in some of its most important particulars, in the articles BONE, HEAD, BRAIN, HEART, CIRCULATING SYSTEM, ABSORBENT SYSTEM, CELLULAR TISSUE, NERVE, STOMACH, BLADDER, LOINS, FOOT, and many others. Animal Physiology is discussed, in one of its departments, in such articles as ORGANIZATION, GENERATION, FÆTUS, GESTATION, PARTURITION, MULE, and SPECIES; in another, in such as FOOD OF ANIMALS, NUTRITION, RUMINATION, DIGESTION, CHYME, and BLOOD; in another, in such as ANIMAL HEAT, RESPIRATION, PERSPIRATION, and EXCREMENT; and in another, in such as ABSORPTION IN ANIMALS, GLAND, SECRETION, and DISEASES OF ANIMALS. And Natural Philosophy is discussed, in reference to light, in such articles as LIGHT and COLOUR; in reference to gases, in such articles as PNEUMATICS, AIR, ATMOSPHERE, and GAS; in reference to fluids, in such as HYDRAULICS, HYDROSTATICS, CAPILLARY ATTRACTION, TIDES, and PUMP; in reference to solids, in such as GRAVITY, COHESION, PRESSURE, and STRENGTH OF MATERIALS; and in reference to forces, in such as MECHANICS, FORCE, ANIMAL POWER, DRAUGHT, and FRICTION.

The Editor of the RURAL CYCLOPEDIA has now nothing more to do for this Work than to record his gratitude to subscribers and reviewers for the very favourable reception it has met,—his admiration of the enterprise and elegance with which the publishers have got it up,—his humble but earnest advice to its readers to rise in every case from its mere statement of practices to its exposition of principles,—and his ardent, happy, increasing hope that, under Divine guidance and favour, the physical and the moral forces of our world, particularly the arts of culture and the great truths of science and Christianity, may so combine their influences and accelerate their action as speedily to achieve for the whole world the prophetic purpose of the All-Benevolent One respecting Zion, that “the wilderness shall be like Eden, and the desert like the garden of the Lord.”

THE RURAL CYCLOPEDIA.

ABATTOIRS.

ABATTOIRS. Public slaughter-houses, first established in Paris in 1810, but not brought into full operation until 1818. They are without the barriers, on the north and south sides of the city. All the butchers of Paris—now exceeding 500 in number—are required to prepare their meat at the abattoirs, under a heavy penalty. The fee charged in 1843, was 6 francs for each ox, 4 for a cow, 2 for a calf, and 10 cents for a sheep.

ABBEY-LANDS. Lands which formerly belonged to monastic establishments. They comprise a large proportion of the surface of Great Britain and Ireland. They often excel the lands which surround them, in both fertility and beauty; and those of England possess interest to the farmer, for their general exemption from the payment of tithes. Some of the abbey-lands, as held by their original monastic proprietors, were tithe-free by real composition; some, by the Pope's bull of exemption; some, by unity of possession,—or in consequence of both the lands and the rectory of a parish belonging to the monks; some by prescription, having been always in spiritual hands, and never having paid tithes, according to the maxim, *ecclesia decimas non solvit ecclesie*; and some, by virtue of the constitutional character of the peculiar monastic order to which the monks belonged. Exemption, up to the time of the Reformation, rested directly on some one of these grounds; but, since the Reformation, it rests on them only through the medium of a special act passed in the 31st year of the reign of Henry VIII. That act, says Blackstone, "enacts that all persons who should come to the possession of lands of any abbey then dissolved, should hold them free and discharged of tithes, in as large and ample a manner as the abbey themselves formerly held them. And from this original have sprung all the lands which, being in lay hands, do at present claim to be tithe-free: for if a man can show his lands to have been such abbey-lands, and also immemorially discharged of tithes by any of the means before-mentioned, [real composition, bull, unity of

ABBEY-LANDS.

possession, prescription, or constitutional character of peculiar order,] this is now a good prescription *de non decimando*. But he must show both these requisites: for abbey-lands, without a special ground of discharge, are not discharged of course, neither will any prescription *de non decimando* avail in total discharge of tithes, unless it relates to such abbey-lands."

The act above referred to, however, [31^o Henry VIII. c. 13,] did not actually dissolve the monasteries; but, after reciting that a great number of religious houses had been voluntarily surrendered to the king, it invests them, as well as all houses afterwards to be surrendered or dissolved, with all their sites, possessions, &c., in the king and his successors. It was the policy of the court to persuade or terrify the occupants of religious houses into the appearance of a voluntary surrender of their possessions.

There are also in Scotland some lands which are tithe-free. These lands are technically said to be held *cum decimis inclusis et nunquam antea separatis*, and, in order to secure the enjoyment of the exemption, must be so described in title-deeds dated before the act of annexation 1587, c. 29. After the Reformation, the crown claimed right to the whole revenues of the regular clergy, and to the estates of bishops and chapters, and also to all benefices which were under ecclesiastical patronage; and early in the reign of James VI. grants had been made by the king or the regents of much of the property so acquired, and particularly of the abbacies and priories, to noblemen and others. These grantees were called lords-of-erection when the estates bestowed on them were erected into temporal baronies, and titulars when they merely received heritable rights to the teinds. After the passing of the act of annexation in 1587, c. 29, whereby the temporalities of benefices were inalienably annexed to the crown, it was no longer entitled to make such erections. James VI., nevertheless, continued to make new grants out of church-benefices. These were all declared to be void,

by act of parliament, 1592, c. 121, excepting such as had been made to persons who had been created lords-of-parliament subsequent to the act of annexation. On the restitution of bishops, in 1606, the act of annexation was repealed, in so far as concerned their benefices. Presbytery was re-established in 1638, but the bishops were again restored in 1662, and held their benefices until the final abolition of Episcopacy in 1689, when they again fell to the crown. But they were then acquired by his majesty, *jure coronæ*, and no new annexation took place. The crown having, thus, the power to deal with these estates at its pleasure, made various grants out of them, to hospitals, universities, and for other public and pious purposes.

The farmer feels no interest in the tithe-free condition of abbey-lands, under the peculiar law of Scotland; and he has lost most of his interest in it, under the recently altered law of Ireland; yet he may almost everywhere see, in the abbey-lands themselves, in their architectural monuments, or in their historical associations, some features which shall give them a distinctive character in his thoughts. Not a few of them were large benefactors to various useful arts; and especially to the arts of gardening and farming.—*Blackstone's Commentaries*, Book ii. c. 3.—*Letters relating to the Suppression of Monasteries. Published by the Camden Society, 1843.*—*Third Report of the Commissioners of Religious Instruction, Scotland, 1837.*

ABDOMEN. The belly of an animal, in which are contained the stomach, intestines, liver, spleen, pancreas, and kidneys. It is lined by a strong membrane called the peritoneum. But by the abdomen of a quadruped is often meant only the lower part of the belly; and by the abdomen of an insect is meant both back and belly, or all the part of the body behind the thorax or corselet, "usually consisting," says Burmeister, "of several consecutive horny rings or segments, in some cases following upon, in others retractile within each other."

ABELE, ARBEEL, or WHITE POPLAR—botanically, *Populus alba*. A well known, deciduous, aquatic tree, of the amentaceous tribe. It is common in Great Britain, and in most other countries of Europe. It grows freely and rapidly, becomes tall and spreading, and is one of the largest of the aquatic trees; yet it seldom attains a height of more than from 40 to 50 feet. It has often been confounded with the grey poplar, or *Populus canescens*, and it is occasionally worked by climate and culture into a close similarity to that tree; yet it constitutes a perfectly distinct and easily recognizable species. Its outline is somewhat deficient in curvature and symmetry; its stem is covered with a grey bark, and sends off numerous branches, which become comparatively long and straggling; its younger branches have a purple bark, coated with a white down; and its leaves are large,—three, four, or five

lobed,—indented on the edge,—of a very dark colour above, but white and downy or rather quite hoary below,—and standing on footstalks of about an inch in length. Old Parkinson's description of the leaves is very accurate. He describes them as "cut into severall divisions, almost like unto a vine leaf, but not of so deep a green on the upper side, and hoary white underneath, of a reasonable good sent, the whole forme representing the leafe of colt's foot." A botanist readily distinguishes the white from the grey poplar, by the shape of its catkins and the number of its pistils; and a general observer, by the obvious contrast of stems, branches, leaves, and outline,—the stem of the grey poplar being unincumbered and silvery, the branches compact, the leaves small and waved, and the outline comparatively regular and massive. Yet the abele has been much modified by local and peculiar influences; it has sported itself into a considerable number of sub-species or varieties; and, in consequence, it is far from being always seen of the same precise form, or with the same minor characteristics. Early in April appear its male flowers or catkins,—cylindrical, scaly, and about three inches in length; about a week later, appear the female flowers; soon after, the male flowers fall; and in five or six weeks after, the seeds are ripened, dropped, and wafted to a distance.

The abele, though systematically ranked as an aquatic, and though decidedly preferring a wet situation, will both strike root and grow in almost any soil. It is propagated readily by cuttings or layers, and very freely by suckers. Cuttings ought to be two or three feet in length; and, if planted in February, to the depth of about 18 inches, in moist or marshy soil, they will speedily form roots, and will, in the course of a few years, acquire a very considerable size. Suckers rise profusely from the decurrent, widespread roots of most healthy trees; and a single stem of white poplar has been known to form by its suckers, in twenty years, a circular clump of 50 feet diameter. The suckers ought to be transplanted in October into a small nursery-bed, and removed in the course of two or three years to the situations in which they are designed to remain. But, in fact, the abele, in common with most of the poplars and the willows, may be treated almost at random; for so tenacious is it of life, and so determined to multiply itself and grow, that sticks of it, pushed into the ground, will strike root, and young plants, in any situation, will soar aloft in derision of maltreatment.

The abele might advantageously cover many a small boggy tract which is otherwise useless; it might, in some rare cases, be raised upon the edge of a spot of spouty ground, to conceal a deformity in a landscape; it might even be permitted to figure as one of the trees of a wet part of a mixed plantation; and it is eminently fitted for forming speedy shelter, or a shaded walk, in a bare, bleak, newly reclaimed expanse of coun-

try; but it can have no place in a wood grown for general profit, and still less in grounds laid out for ornament. To place this tree upon good soils, on pasture lands, in arable fields, in hedge-rows, in the vicinity of villas, on the side of small gardens, or as a shade to the cottage or the farmery, is an outrage upon both good taste and common sense. The abele impoverishes land, spreads out a wide mat of exhausting roots, attracts noxious insects, vulgarizes villa-ground, looks derision upon a parterre, and proclaims its planter in such situations to be a jackanapes who would plant gorse athwart a vineyard, or grow cabbages in a rosary. The extreme facility with which it takes root and grows, ought not to provoke even a poor man to prefer it to a better tree.

The uses of the abele as timber have been very variously stated, and by some writers, such as Miller, Hartlib, and Pontey, have been highly extolled. This timber has been recommended as, in some instances, superior to the oak, on account of its exceeding whiteness; as very suitable for flooring, and fitted to endure in that capacity for many years, if it has been seasoned two or three years before using; as excellent for wainscoting, on account of being less subject to swell or shrink than most other timber; as eminently suitable, on account of its whiteness and facility of working, for the manufacture of trays, bowls, and other wooden utensils; as excellently adapted for the purposes of the bellows-maker, and of the manufacturer of wooden soles of shoes; as good for light carts; as excellent for laths and packing-cases; as very superior for wooden constructions under water; and, in fact, as available for an almost innumerable variety of purposes, from the mean ones of fuel and poles, to the noble ones of tools and furniture. Pontey even asserts it to be perfectly suitable for almost every article usually made of mahogany, and quite capable of being stained and doctored into a very close imitation of that valuable wood. Its only true uses, however, or those in which it excels most other wood, are for turnery, packing-cases, and water-works.—The name abele is derived from the Low Dutch *abeel*, and was suggested by the hoary appearance of the tree; and the name poplar, which the abele shares with other species, is derived from the Latin *populus*, or the French *peuplier*. The tree, therefore, has not a properly English name, and cannot be regarded as of English origin. It is a native of Europe and of North America; and is also found in Asia and in Northern Africa. See articles **POPLAR** and **PLANTING**.—*Miller's Gardener's Dictionary*. V. *Populus*.—*Marshall on Planting*.—*Nicol's Planter's Kalendar*.—*Pontey's Profitable Planter*.—*Phillips' Shrubbery*.—*Treatise on Planting in the Library of Useful Knowledge*. *Loudon's Encyclopædia of Plants*.

ABIES—popularly the **FIR**, or the **SPRUCE FIR**. A portion of the large, beautiful, and highly impor-

tant tribe of needle-leaved and cone-bearing trees. The firs possess such accommodating habits, such handsome foliage, and so elegant an appearance as to be general favourites for at once forests, clumps, and pleasure-grounds; and they share with other portions of the cone-bearing tribe a value as timber-trees which is scarcely second to even that of the oaks. The genus abies was formerly included in the genus pinus, and is still very often confounded with it; yet it may be readily distinguished by its leaves being solitary, or issuing from one scale or sheath on the bark of the branches, while those of the pinus are gathered or amassed in bunches, and also by its outline presenting some resemblance to a cone or pyramid, while that of the pinus is comparatively irregular and broken. For some time after its erection into a separate genus, the abies included some rare, curious, and more or less tender species, which are now arranged in several distinct genera; and even as at present constituted, it has recently been broken up by some botanists into the four genera of abies or spruce fir, larix or larch, picea or silver fir, and cedrus or cedar. The spruces, or species of the abies proper, are characterized by the leaves growing singly round the branches, and all spreading equally; the silver firs or species of picea, by their leaves growing singly round the branches, and being all turned toward one side; the larches or species of the larix, by their leaves growing in clusters, and being deciduous; and the cedars or species of the cedar, by their leaves growing in clusters, and being evergreen. But the several divisions will be more fully noticed, and their habits, culture, and uses stated in the articles **FIR**, **SILVER-FIR**, **LARCH**, and **CEDAR**. We possess a list of about seventy species of abies and pinus, collected from North America, Canada, Mexico, the Himalaya mountains, and Europe. In the latter great division of the world, this group is universally diffused, from the Arctic circle to the shores of the Mediterranean.

ABLACTATION. The weaning of a young sucking animal: also the grafting of trees by the method better known as inarching or grafting by approach. See **GRAFTING**.

ABLAQUEATION. An absurd and obsolete practice in arboriculture. It consisted in laying bare the roots of young trees during winter, that they might be freely exposed to the action of air and weather, and might acquire habits of hardiness and sturdy growth; but it was found to be mischievous, and was universally abandoned.

ABNORMOUS, or **ABNORMAL**. Not conformable to rule. Irregular.

ABOMA'SUS. The fourth and lowermost, or true stomach of ruminating animals.

ABORTION. The premature expulsion of calf, lamb, or foal from the womb. What constitutes abortion, as distinguished from a birth, is the appearance of the foetus in so incomplete a state of its formation as, if life exist, to render

the continuance of it impossible. An abortion among live stock is, in popular language, sometimes termed a miscarriage, and sometimes a casting or warping, but more commonly a slipping or slinking. The indications of approaching abortion are sometimes the sudden filling of the udder as in the approach of parturition, sometimes the flow of bloody matter from the vagina, and more generally great restlessness and languor. The precurent circumstances are the death or mortal disease of the fœtus, and the disturbance or derangement of the functions of the womb; and the usual causes—though these, as well as the symptoms, exhibit modifications in the different classes of animals—are falls, bruises, or other accidents,—over-driving, sudden exertion, or unwonted fatigue,—such excess or deficiency of food as to occasion fatness or emaciation,—such severe fright as violently to agitate the nerves,—and even such foetid smells or putrid sights, as excite disgust, or induce a morbid sympathy.

Abortion in the Cow.—Abortion occurs oftener and more readily in the cow than in any other animal; and is one of the most vexatious classes of occurrences on a farm. A cow which has once been afflicted with it can never be depended on for further breeding, but would very probably miscarry on every future occasion as on the first; and hence, to prevent repeated disappointments and losses, she must be discarded from the cow-house, and fattened for the butcher. The loss of her calf also occasions a blank in the number of live stock to be brought up during the season, and obliges the farmer to procure a young animal by purchase. Yet any farmer who happens to be tried with the occurrence, must have a fair knowledge of the numerous causes of abortion, and must exercise considerable assiduity and skill in the use of preventives and remedies, in order to his probably escaping far worse consequences than the miscarriage of a single cow, and the necessity of purchasing a single calf.

Abortion sometimes becomes remarkably frequent, and even appears to assume an epizootic or epidemic character, in particular districts, or upon particular farms. Chabert, in his *Veterinary Instructions*, relates an instance of a farmer at Toury, who unwittingly introduced an abortive habit among his cows by the purchase of a strange cow at a fair,—who witnessed the transmission of the habit, apparently from that one animal, to all his breeding-cows, during the long period of thirty years,—who could discover nothing in either the previous condition or the current treatment of any of his cows to indicate a predisposition to the habit,—who sold off cows that had aborted, purchased seemingly sound cows in their stead, rebuilt his cow-house, altered the whole economy of his live-stock, repeatedly changed his bull, and tried every other expedient he could think of to put an end to the pest,—

and who was baffled at every step, and tortured to see the abortive habit as prevalent and powerful as ever, until at last he sold his whole herd, and introduced an entirely different set of animals, altogether free from sympathy with any individual of his former set of cows. Both this instance and many other instances of a similar character seem, at first sight, to indicate the existence of some contagious or infectious virus in the cow's abortion; but, when more carefully considered, they show the disorder to be propagated rather by the sympathies of a delicate smell, by the keen power of an irritable imagination, or by some other influence of an equally subtle nature, and altogether peculiar to the cow. "A more common cause of slinking than any others," says Mr. Skellett, "and which is peculiar on the influence of this animal, is a disagreeable, nauseous smell. The cow is remarked to prepossess a very nice and delicate sense of smelling, to that degree, that the slinking of one cow is apt, from this circumstance, to be communicated to a great number of the same herd: it has been often known to spread like an infectious disease, and great losses have been suffered by cow-feeders from the same." "Some," says Mr. Youatt, "have imagined abortion to be contagious. It is destructively propagated among cows; but this is probably to be explained on a different principle than that of contagion. It has been stated that the cow is an animal considerably imaginative, and highly irritable during the period of pregnancy. In abortion, the fœtus is often putrid before it is discharged; and the placenta, or after-birth, rarely or never immediately follows it, but becomes decomposed, and, as it drops away in fragments, emits a peculiar and most noisome smell. This smell seems to be singularly annoying to the other cows—they sniff at it, and then run bellowing about. Some sympathetic influence is produced on their uterine organs; and, in a few days, a greater or less number of those that had pastured together likewise abort." These views, though not demonstrable nor even tolerably certain, are very far from being unphilosophical; and as they possess quite as much force as any plausible theory, they ought to induce every farmer and cow-feeder to keep the cow-house of breeding cows in a clean, sweet, and well-ventilated condition,—to attend to the frequent and thorough cleansing, not only of the feeding-troughs, but of the urine gutters,—to protect the straw or other material for the litter of the cows from any stain of blood or putridity,—to cut off, promptly and finally, all vicinity of an aborted cow from other breeding animals of the cow-house,—and to remove and inhume, with all speed, every vestige of the uterine discharge. Such practices, however, as the fumigation of the cow-house, the burning of feathers, tar, and sulphur, and the smearing of the parts of the cow with tar or fetid oils, as means of destroying smell and preventing contamination, ought either

to be wholly avoided or very cautiously observed; for they have not been known, in even one instance, to produce a decidedly good effect, and they, in all cases, incur a hazard of creating the very evil which they are intended to avert. The transmission of the abortive habit in the seemingly epizootic form, is confessedly an obscure subject,—possibly yet untraced to its real cause,—and certainly ill combated by any remedies yet devised; and hence every intelligent farmer will deal with it according to the best of his own judgment, and keep his mind open to any explanations of it which accident or observation may disclose.

The causes of the abortion of the cow, in its more common forms of occurrence, are better known.—One of these causes is overfeeding. Cows, when in an extravagantly high condition, are in continual excitement, and constantly liable to inflammation of the uterus, and consequent abortion. M. Cruzel narrates that three cows out of ten, belonging to a certain farmer who consulted him, aborted in the first year of their breeding,—that two of these three aborted also in the second year, whilst the third produced a feeble calf which died on the second day,—that a fourth of the ten cows aborted in the third year,—that, on then being called in to examine and prescribe, he observed all the cows to be in an unnecessarily high condition, and drew blood from them all, and ordered a material reduction in the quantity of their food,—and that, as the result of his treatment, their habit of abortion was completely removed.—Another cause is the feeding of cows with bad hay. Mr. Lindsay states that no fewer than ten out of twenty-two cows of a respectable friend of his who kept a dairy aborted in one year,—that other animals of his friend's stock, contracted diseases, some fatal and most of them disastrous, about the same period,—and that both the abortions and the other diseases were clearly traceable to the unavoidable feeding of the cattle with very badly saved or very badly preserved hay.—A third cause is the autumn grazing of the cow upon fields thickly covered with hoar-frost. In Switzerland, abortion, though occurring at all seasons of the year, sets in with virulence and becomes multiplied tenfold, at the period when hoar-frost begins to appear on the fields. This cause of abortion, however, may be resolved into the more general one of feeding cows on any pasture which has a tendency to produce inflammatory disorders. Cattle of all kinds are exposed to serious injury, and sometimes incur palsy of the rumen or dangerous inflammation of the bowels, from feeding in autumn upon fields covered with hoar-frost; and whatever has a tendency to create general excitation in the bestial system, is likely, during the pregnancy of the cow, to produce inflammation of the womb.—A fourth cause is grazing upon pastures containing acrid plants, or upon the coarse, rank herbage of low, marshy, and woody grounds. This cause

operates with great force also in producing the disease called Red-Water: see article RED-WATER.—A fifth cause is the drinking of stagnant or putrescent water. Mr. White mentions that three successive tenants of a farm near Berkeley in Gloucestershire relinquished possession in consequence of serious losses in cattle by abortion, red-water, and other diseases,—that a fourth tenant suffered similar losses during five years, but eventually observed his cattle-pond to consist of stagnant water, impregnated with dung and urine, and suspected this to be the source of his cattle's disorders,—and that he shut up the pond, procured a supply of good spring water by digging or boring, and was rewarded both by the disappearance of all disease from among his cows, and by a great improvement in the quality of the butter and cheese manufactured from their milk.—A sixth cause is the drinking of water impregnated with iron. A writer in a German periodical states that, in 1822, twelve of his pregnant heifers, which drank from ponds of water strongly impregnated with iron, cast their calves,—that, in 1823, twelve other pregnant heifers drank from the same ponds, and likewise cast their calves,—and that, in 1824, ten cows which drank other water safely calved, while one cow which drank of the ferruginous water aborted.—A seventh cause is feeding with hard, unsucculent food, or occasioning cows to drink large quantities of water. Mr. White states that, in January 1782, all the cows of a farmer near Grandvilliers in Picardy miscarried,—that they had been kept upon the straw of oats, wheat, and rye, and had been obliged to drink large quantities of bad water in order to obtain sufficient nourishment from the straw,—and that the causes of their miscarrying appeared to be the distension produced by the large quantities of water which they drank, and the injury sustained by the third stomach in expressing the fluid parts of the masticated mass. Mr. White also states that, in one year, sixteen out of twenty-eight cows in a dairy at Charentin miscarried,—that, during the preceding season, which had been unusually dry, the cows had been pastured in a muddy place, flooded by the Seine, and had generally stood up to the knees in mud and water, feeding on crowfoot, rushes, and other similar vegetation,—and that some of them had, not long before, been brought from Lower Normandy, where they had suffered indigestion from feeding on lucerne, and had obtained relief by the operation of paunching. Mr. White likewise mentions that, in 1789, all the cows in the parish of Beaulieu, near Mantea, miscarried; and states that all the land of that parish is very retentive of water, and that so much rain fell upon it in 1789 as repeatedly, and for long periods, to flood all the pastures, so that the grass became rank and sour.—An eighth cause is the too great weight, or some other unsuitable property, of the bull. The use of a too heavy male among the breeders of sheep, is an error well understood, and every-

where exploded; but it was formerly very common among the breeders of black cattle, and even yet is occasionally practised. Many instances might be named of the infliction of serious damage by a great, overgrown bull; and an instance is mentioned by Mr. Wedge of a bull which caused a whole dairy of nearly twenty cows to abort in one year,—which was sold to a neighbouring farmer, and caused all his cows also to abort,—and which, on being repurchased by the original owner, and again put to the trial, caused another set of cows to abort.—A ninth cause is a cow's being afflicted with catarrh, or having a tendency to consumption. A cow long subject to catarrh rarely becomes pregnant, or, if she does, is very likely to cast her calf; and a cow which has become actually consumptive is almost certain to miscarry.—A tenth cause is a cow's being subject to hoove or flatulent distension of the stomach, or her being so placed while pregnant as to incur hoove. Any considerable distension of the rumen seems to press so strongly on the fœtus as to injure or destroy it; and even an inconsiderable distension, if suddenly produced by change from poor to luxuriant food, often occasions abortion. Cows which have been half-starved on meagre herbage during winter, and have been incautiously removed to a rich pasture in the spring, are in much hazard of miscarrying. A farmer whose dairy has hitherto been free from the mischiefs of abortion, ought, on purchasing every new cow, to ascertain her previous habit of feeding, lest by too sudden a change she incur hoove, and acquire a habit of miscarrying.—An eleventh cause is either a costive or especially a relaxed condition of the bowels. "It must be observed," says Skellet, "that, though it is necessary to preserve a free state of the bowels, a laxity of them will often produce abortion. Cows fed very much upon potatoes, and such other watery food, are very apt to sink, from their laxative effects. In the food of the cow, at this time, a proper medium should be observed, and it should consist of a due proportion of other vegetable matter mixed with the fodder, so as the bowels may be kept regularly open, and no more."—A twelfth cause is fright. Various instances have occurred of whole herds of cows having cast their calves in consequence of the terror of an extraordinary thunderstorm; and more than one instance may have been seen or heard of by almost every farmer, of individual cows having been driven to abortion by common frights.—A thirteenth cause, and rather frequent one, is connexion with the bull after the commencement of pregnancy.—A fourteenth cause is injury from fatigue, from the blows of the cow-herd or of other persons, or from the contacts of other cows in season or of unskilfully castrated oxen.—A fifteenth cause is similar to one of those assigned for the apparently epizootic character which abortion occasionally presents,—the prevalence of any bad odour. "Of what nature that odour is which gives offence," says Skellet, "we

cannot altogether be certain; but the author has remarked that its effects occur at one season more than at another, and particularly when the weather has been wet, and the cows have long been kept at grass. From this fact, it will appear that the smell is of a vegetable nature, and connected with their feeding at that time."—Yet though so many causes of abortion have been distinctly ascertained, and may, with more or less frequency, be still found in operation, instances of abortion occur in the case both of individual cows and of whole herds for which no apparent cause can be assigned. The *Leipsic Agricultural Gazette* of March 22, 1777, states that, "by an unheard-of fatality, the abortion of cows in that district was almost general, and that, after the most anxious research, no assignable cause for it could be discovered, nor would any medicine or medical treatment arrest the plague." In 1784, according to Chabert, all the cows and mares at Chalons, from cause or causes quite unknown, aborted; and in 1787, all the cows at Bournonville, though they had been in the cow-house during the whole winter, and had been well taken care of, cast their calves.

The suitable preventives of abortion, in the case of individual cows, are distinctly suggested by the causes of the disorder, and need not be mentioned in detail. But as some of the causes are only occasional, and some can exist only in peculiar localities or under unusual circumstances, and some are liable to come obscurely as well as suddenly into operation, each farmer ought to determine to which of the several causes his particular farm or herd is most likely to be obnoxious, and to adopt his principal preventives against what he believes to be the most likely causes. Yet a few precautions or modes of protective treatment are desirable, and even necessary, on almost every farm,—such as the regular feeding of the cows, the use of only good food and in moderate quantities, the affording of free access to good water, the cleanliness and perfect ventilation of the cow-house, the avoiding of all sudden exposure to considerable increase of heat or cold, the checking of all tendency to plethora or undue fulness of habit, the cautious but steady counteraction of any tendency toward emaciation, the adapting of particular varieties of food to the particular tastes of the several animals, the gentle correction of any tendency toward either constipation or relaxation of the bowels, the prohibition of all rough usage on the part of the cow-herd, and the various little arts of consideration and kindness which are suggested to good feeling and sound judgment by a knowledge of the cow's delicate organisms and comparatively tender susceptibilities. Only a brutal-minded cow-owner will pronounce such attentions too refined for a mere animal; only a lazy and sluggardly one will think them too troublesome for his observance; and only one of narrow knowledge, ill-trained principles, and wasteful econo-

my will regard them as unnecessary to the remunerative working of his dairy.

The abortion of the cow takes place at various stages of pregnancy, from the half of the usual period of gestation to the end of the sixth, and even the end of the seventh month. The symptoms of its approach bear some resemblance to the indications of approaching parturition; but as they are often much feebler than these, and are usually not expected, and sometimes occur only under the observation of the cow-herd or other parties who may be implicated in causing them, they are exceedingly liable to escape the notice of the proprietor till they have become greatly aggravated, and gone quite beyond the reach of remedy. In its earlier stages, the cow loses appetite, ceases rumination, becomes dull and oppressed, suffers a slight enlargement of the abdomen, staggers a little in her walk, prolongs the periods of reclining, and stands a comparatively long time motionless after rising; and in its later stages, she loses the natural roundness of the abdomen, begins to express pain by moaning, exhibits a small, wiry, and intermittent pulse, shows laboriousness and slight convulsiveness of breathing, and discharges a yellow or red glairy fluid from the vagina. The last of these symptoms is almost always decisive. But in certain cases, particularly when the abortion is caused by violence or extreme fatigue, the animal evinces such severity of suffering as cannot be mistaken,—she ceases not only to ruminate but to eat, paws the ground, rests her head on the manger while she is standing or on her flank when she is lying, suffers either uterine hemorrhage or a spasmodic contraction of the uterus, and endures a succession of very violent throes for the expulsion of the foetus.

The calf or foetus, in the majority of cases, is expelled dead or putrid; and in other cases is so imperfect and feeble, that it very rarely lives. When an occasional case does occur of the expulsion of a well-formed living foetus, or of delivery at a comparatively advanced stage of pregnancy, a doubt might probably arise as to whether it is properly an abortion or a parturition; for so considerable a variation exists in the actual period of healthy gestation among cows, that M. Tessier observed, in 1,131 instances, a minimum of 240 days, a maximum of 321 days, and a consequent extreme difference of no less than 81 days. The effects of abortion upon the cow, even in their mildest form, but especially in bad cases, are often very serious. When the foetus has been several days dead, and the uterus experiences considerable spasmodic action, and the labour is difficult, prolonged, and very painful, the cow is much more exhausted than in natural parturition,—she acquires little or no appetite, and yields no milk,—she appears feeble, wasted, and as if shrivelling into meagreness of bulk,—she probably contracts some internal chronic disorder, or the elements of consumption,—and

she either drops away into death, or recovers with slowness and difficulty. Even when the abortion is of mild form, and entails no seemingly disastrous consequences, the cow loses much of her strength and character as a breeder,—she will almost certainly not become pregnant on the next occasion of being in season,—she may acquire a kind of nymphomania, and become a nuisance among a herd,—and, as already stated, when she does again become pregnant, she is almost certain to have another abortion. Some persons assert, indeed, that the enfeeblement of the system is only temporary,—that each succeeding abortion occurs at a later and later period of gestation,—and that in the course of three or four years, the cow, if properly treated, will overcome her habit of abortion, and become a tolerably safe breeder. But no farmer, who has a due regard to his own interest, will keep an unprofitable animal for so long a period upon his premises; nor, for the sake of remote and contingent good, will he incur the serious hazard of spreading the abortive disorder among the rest of his breeding stock. The aborted cow, whenever she begins to recover, ought to be fattened and sold; and in any case in which there is an unconquerable reluctance to part with her, she ought, at all events, to be kept separate from her companions for at least two months, and if possible for ever.

If abortion be suspected, and the earlier symptoms of it be observed, the evil may, in many cases, be averted. A cow which seems to be menaced with it ought to be instantly removed from the field to a comfortable shed or cow-house, away from the other cattle. If the fluid she discharges be only glairy but not offensively smelled, and especially if any motion of the foetus can be observed, the threatened abortion may possibly be averted. "The farmer," says Mr. Youatt, "should hasten to bleed her, and that copiously, in proportion to her age, size, and condition, and the state of excitation in which he may find her; and he should give a dose of physic immediately after the bleeding. The physic beginning to operate, he should administer half a drachm of opium and half an ounce of sweet spirit of nitre. Unless she is in a state of great debility, he should avoid above all things 'the comfortable drink,' which some persons so strangely recommend, and which the cowleech would be almost sure to administer. He should allow nothing but gruel, and he should keep his patient as quiet as he can." The quantity of blood proper to be drawn from a cow in good condition may probably be five or six quarts; and the dose of physic suitable after bleeding may be either half a pound of Epsom salts, or three or four drachms of powdered aloes, or three or four ounces of castor oil, administered in a quart of gruel. But should the animal be in very poor condition, and her bad symptoms have been induced by exposure to cold, bleeding ought to be dispensed with,

and the chief reliance placed upon gruel and an opiate.—When the symptoms earliest observed are indicative of death in the foetus, and especially when the fluid discharged by the cow has a decidedly offensive smell, abortion may be regarded as inevitable, and should on no account be attempted to be hindered, but by every fair and possible means be expedited. The cow, if much fever exist, ought to be bled: she may even, in some cases, receive with advantage 'the comfortable drink' which cow-leeches so indiscriminately administer; and she ought, in all other respects, to be treated in the same manner as for parturition. The grand difficulty is, not with the foetus, but with the placenta or after-birth. The foetus, instantly on being obtained, ought to be buried deep, in some spot which no cow is likely ever to frequent; and the placenta, in consequence of being in an unprepared state to separate from the womb, and of the probability of its being so long retained as to contract putridity or corruption, ought to be the subject of prompt and sedulous concern. "A dose of physic," says Mr. Youatt, "should be given; the ergot of rye should be administered; the hand should be introduced, and an effort made, cautiously and gently, to detach the placenta: all violence, however, should be carefully avoided, for considerable and fatal hemorrhage may be speedily produced." Yet, whenever the placenta does not easily yield to ordinary appliances, or come away in the course of a few hours, or at the utmost a day, the farmer will do well to call in the aid of a veterinary surgeon. Skellet recommends, as a means of bringing off the placenta, to administer to the cow, when fasting, a drink containing 3 oz. of juniper berries, 2 oz. of bay berries, 1 oz. of saltpetre, 1 oz. of anise seed, $\frac{1}{2}$ oz. of gentian, $\frac{1}{2}$ oz. of myrrh, $\frac{1}{2}$ oz. of assafœtida, 1 quart of mild warm ale, and 1 quart of pennyroyal tea, and to repeat the dose daily till all the placenta be evacuated. But such compound and intricate drugging wants the simplicity of the best veterinary practice; and at all events ought scarcely to be practised or imitated by the farmer, in indiscriminate cases, or without competent advice. Youatt, immediately after the passage which we have already quoted from him, says, "The parts of the cow should be well-washed with a solution of the chloride of lime; and this should be injected up the vagina, and also given internally. In the meantime, and especially after the expulsion of the placenta, the cow-house should be well-washed with the same solution."—When abortion has once occurred on a farm, the breeding cows ought, for a year or two, to be watched and treated with unusual care,—they ought to be sedulously protected from the various causes by which abortion is induced,—they ought to be well fed, yet not suffered to become fat,—and unless they happen to be very lean and weak, they ought, between the third and fourth months of every oc-

casion of pregnancy, to be bled and mildly physicked.

Abortion in the Ewe.—Abortion in the ewe is not so common as abortion in the cow, and seldom if ever assumes an epizootic appearance; yet it is sufficiently frequent to be a great annoyance, and is sometimes so extensive as to disarrange all the sheep-owner's plans, and entail upon him very serious pecuniary loss. It may occur at any stage of pregnancy, but happens most frequently about mid-time of gestation. Its causes are unusual storminess of the weather, the endurance of fatigue in snow, over-driving, sudden fright, leaping over hedges or ditches, annoyance from the ferocity of dogs, the too free use of salt, and, above all, profuse and unqualified feeding upon turnips and other succulent food. The last of these causes, indeed, does not always operate, and may often appear to a sheep-farmer to be perfectly innocuous; yet in seasons when an abundant vegetation in autumn is followed by an unusual proportion of wet weather in winter, it is almost certain to operate with great virulence and to a wide extent. Mr. Spooner states that, only a spring or two ago, numerous instances occurred in Southamptonshire of the use of succulent food occasioning abortion in ewes; and he mentions a particular instance of a farmer who, at that time, had nearly a hundred aborted ewes, a good many of which died. These ewes, he says, "had been turned on a fine field of turnips, and subsisted entirely on them and water-meadow hay for some time previous to the commencement of the mischief, which began soon after Christmas, and continued for several weeks. Though the greater number of ewes recovered, yet they suffered much, and some died from inflammation of the womb, and others became paralyzed."

The symptoms of approaching abortion in the ewe, in consequence of the woolly covering of the animal, cannot be so well observed as those in the cow; yet a listlessness in the creature's movements, and a redness under the tail, may excite the notice of any ordinary shepherd,—and a loss of appetite, an unusual degree of bleating, a moping manner of separation from the flock, and occasionally trembling over the body, slight labour-pains, or even the relaxation of the uterus, may confirm suspicion when once it is fairly aroused.

Pregnant ewes ought never to be fed upon a turnip field, but ought to be placed upon dry pasture-ground, and either abundantly supplied with hay, or moderately fed with drawn and carried turnips, sliced and mixed in troughs with chaff or with bruised corn. Such treatment may possibly impair their condition, but will at least prevent the more serious calamity of their aborting. The treatment, when abortion actually occurs, ought to vary with the circumstances of particular cases, and must be, in some degree, similar to that of aborted cows. "If," says Mr. Youatt, "the foetus had been long dead, proved

by the fetid smell of it, and of the vaginal discharge, the parts should be washed with a weak solution in water (1 to 16) of the chloride of lime, some of which may also be injected into the uterus. If fever should supervene, a dose of Epsom salts, timeously administered, will remove the symptoms. If debility and want of appetite should remain, a little gentian and ginger, with small doses of Epsom salts, will speedily restore the animal. Care should be taken that the food shall not be too nutritive or too great in quantity." Mr. Spooner recommends that the ewe be placed in a sheltered situation away from the rest of the flock, that she be allowed plenty of fresh air, that she receive on the first day $\frac{1}{2}$ oz. of Epsom salts, 1 drachm of laudanum, and $\frac{1}{2}$ a drachm of powdered camphor in some nourishing gruel, and that she receive also on the second day the second and the third of these medicines, but not the salts unless she happen to be constive. The aborted objects ought to be carefully and deeply buried, and ought not to be approached by the shepherd lest he should convey infection from them to some other ewes of the flock.

Abortion in the Mare.—Abortion in the mare is not infrequent. Its usual causes are over-exertion, falls, kicks, and improper feeding. A pregnant mare may sometimes be seen on the worst pasture of an injudiciously conducted farm, half-starved on insufficient herbage, and totally deprived of the nutritive feeding and the special care bestowed upon working horses; and, in such circumstances, she incurs considerable hazard of miscarrying. She does not require, indeed, to be fed in the same high manner as if she were fully and constantly at work; yet she ought to have a little better food than common herbage during the whole period of gestation. She ought to receive one or two feeds of corn a-day during the latter half of that period, and she will be all the better, and none the worse, to perform moderate work till within a few days of the calculated time of parturition. If, on the other hand, she be unduly indulged, and too luxuriously fed, she will incur risk of inflammatory action throughout her system, of excitement and disturbance in the uterine organism, and of consequent abortion with aggravated and dangerous accompaniments. The most common period of abortion in the mare, as in the ewe, is about mid-gestation. "Good feeding and moderate exercise," says Mr. Youatt, "will be the best preventives of this mishap. The mare that has once aborted is liable to a repetition of the accident, and therefore should never be suffered to be with other mares between the fourth and fifth months; for such is the power of imagination or of sympathy in the mare, that if one suffers abortion, others in the same pasture will too often share the same fate. Farmers wash, and paint, and tar their stables, to prevent some supposed infection;—the infection lies in the imagination."—*White's Natural History.*—*Skellet on the Parturition of the Cow.*—

Clater's Cattle Doctor.—*Chabert's Instructions Veterinaires.*—*Youatt on Cattle.*—*Youatt on Sheep.*—*Spooner on Sheep.*—*Youatt on the Horse.*

ABORTION. An accidentally barren or an immaturable condition in the seeds or seed-vessels of plants. True barrenness consists in the total absence of seed, or of the organs which form it; but abortion consists in the stopping and defeating of the actual process of the seed's formation. Thus a flower falls off, without being followed by a fruit or seed-vessel; or a fruit, a receptacle, or a legume is fairly formed, but, instead of coming to perfection, shrivels, corrupts, and falls. The most common causes of abortion are injuries to the flower, from the weather or from abrasion,—to the incipient fruit or seed-vessel, from insects or from ill-usage by man,—to the leaves, from insects, particularly the catterpillars of moths and butterflies,—to the fruit-stalks, from insects, particularly the aphidæ and the cocci,—and to the roots, from exposure to the atmosphere, or from a too free use of the knife or hatchet. Other causes might be named; but they are more properly noticed in the article on the diseases of plants, and other articles there indicated. See article DISEASES OF PLANTS.

ABORTIVE CORN. A diseased condition of growing corn, prominently noticed nearly a century ago in France. A chief description of it occurs in a prize essay of M. Tillet, presented to the academy of Bourdeaux; and this description is, in substance, adopted both in English agricultural works of eighty years ago, and in agricultural works of the present day. The distemper of abortive corn, says M. Tillet, shows itself long before harvest, when the stalk is not more than 18 inches in height, and may be known by a deformity in the stem, the leaves, the ear, and even the grain. The stems of plants affected by the distemper are generally shorter than those of other corn-plants of the same kind and age; and are crooked, knotted, and fragile. The leaves are usually of a bluish green colour, and curled up in various ways,—sometimes like wafer-cakes, and often in a spiral form. The ears have very little of a natural shape; and they are lean and withered, and show very imperfect rudiments of either the chaff or the grain. All these symptoms, however, occur only in the most thoroughly distempered plants. The stems are often pretty straight, the leaves but little curled, and the chaff tolerably well formed; but the last of these, instead of enclosing a small embryo, white and soft at the summit, contains only a green kernel, terminating in a point, not unlike a young pea when forming in its pod. The abortive kernels have two or three very visible points, and are then fashioned as if two or three were joined at the base; and when they acquire their ultimate condition, they become dry and black, and possess so close a resemblance to the seeds of cockle, as to be readily mistaken for them by farmers unacquainted with the distemper of abortive

corn. M. Tillet suspected the distemper to be occasioned by insects; and he observed on the sickly plants small drops of a very limpid liquid, which he believed to be extravasated sap.

ABRASION. A superficial excoriation, with loss of substance, under the form of small shreds, in the mucous membrane of the intestines. Also, an ulceration of the skin possessing similar characters.

ABSCESS. A collection of pus or of other matter, in a limited cavity under an animal's skin. It is the result of a morbid process, and may be induced by either an external cause, such as a bruise, or the insertion of a nail or thorn, or by some internal cause, such as peculiarity of constitution or impurity of blood. It differs from an ulcer in this, that in the latter the pus is formed from a surface exposed to the air. While the abscess is forming, the skin is usually very tender, the whole system is sometimes in a state of considerable irritation, and the part immediately affected is always the seat of pain, swelling, and an unusual degree of heat. A watery or dropsical swelling, on being pressed, retains, for some time, the mark of the fingers; and an emphysema, or windy swelling, called technically *abscessus spirituosus*, is even more yielding than the watery tumour; but a true abscess, though also in some degree elastic or imcompressible, resumes its former shape the instant the pressure is removed.

Any abscess is bad in nearly the proportion of its hardness, redness, and power of resisting pressure. If an abscess, in its earlier stages, be yielding and well-supplied with fluid, it soon softens, 'points,' diminishes in pain, and approaches a state of maturity. At the time of the abscess 'pointing,' the matter of it can be felt more distinctly at one particular part than in any other part, and a tendency appears at this particular part to burst, and to let out some or all of the collected matter. The bursting, however, "should not be permitted; but at this stage, the abscess should be opened at the lowest part, or that which would admit most readily of its discharging itself. The opening should be large, and no dressing will be required except the continuance of the fomentation, which should previously be used. It should be observed, that if the abscess is languid and slow in forming, a stimulant, such as harts-horn and oil, rubbed in occasionally, will be useful." The wound ought to be kept quite clean; the edges of it ought to be trimmed of their hair or wool; a bran poultice may be applied as a substitute for a foment; and, if the wound be very slow in healing, a liniment consisting of equal parts of sweet oil and spirits of turpentine may be injected once or even twice a-day, and the animal may be indulged with an increased degree of nutritiousness in its food. The stuffing of the wound with tallow, tow, or other materials, as is often practised by empirics, tends at best to retard the process of healing, and may

possibly produce a far worse distemper than that which it is intended to remove.

When an abscess forms under a part of the skin which is thick and inelastic, or in any part which will not readily distend, so as to accommodate itself to the collection of distempered matter, it is more likely, than in ordinary cases, to escape for a time the observation of the proprietor or his servant, and is attended with much more pain, far more serious consequences, and several additional and strongly sympathetic symptoms to the animal. An abscess in the foot of an irritable horse, for example, is sometimes a cause of death; and abscesses in various other concealed and resisting parts of the body, occasionally baffle even a skilful veterinary surgeon by their intricate symptoms, and are not absolutely known to exist till the animals die of them and are dissected. Such exceedingly bad cases are happily not frequent; and when they do occur, they may reveal themselves to the diagnosis of the general practitioner, though scarcely to that of the mere veterinary surgeon, by the animal's loss of appetite, his hot skin, his constipated bowels, his quick and hard pulse,—or, in one word, by his suffering a fever for which no other cause can be discovered. Some distempers which present a considerable resemblance to an abscess, yet really differ from it, will be noticed under the word **TUMOUR**.

ABSCISSION. The act of cutting-off or lopping one soft part from another, whether in animals or in plants.

ABSENTEEISM. The stated residence of a landowner in another country or district than that in which his estates are situated. The practice prevails, to some extent, throughout the United Kingdom; but it is especially, or on a very large scale, prevalent in Ireland, and has long been regarded by a large proportion of the community as one of the chief causes of that country's comparative poverty and depression. The mere stated residence of a landowner upon his property is not necessarily beneficial to his tenantry; for if he take no direct interest in the advancement of their well-being,—if he regard them as beings of an inferior order, who have few or no sympathies and interests common or reciprocal with his own,—if he be ignorant of agriculture, and manifest indifference or contempt for its pursuits,—if he exact the highest possible rents, and appoint a mere man-receiver to collect them,—if he evince more concern for the enlargement of his income than for the agricultural competency of his farmers and the georgical improvement of his estates,—and, above all, if he be a spendthrift, a gambler, a madcap sportsman, a dissolute and domineering aristocrat, a contemner of sound morals, and an encourager of irreligion and profanity,—he is a sheer pest, an enormous nuisance, a mass of stenchy, fermenting compost in the midst of his people, and the sooner he is carted away from them, the more likely will they be to prosper.

The mere stated non-residence of a landowner of altogether opposite character—of comprehensive mind, sound judgment, patriotic feelings, and enlightened, benevolent, religious concern for the best interests of his tenantry—is not necessarily an evil, but may be, to a very large and benign degree, compensated by the practice of a wise and paternal system of agency. Some landlords, as those holding offices of national trust, are in a great measure absentees from a necessary regard to public duty; some, as those who have much affliction either in their own person or in that of their immediate relatives, are sometimes absentees from a due regard to domestic obligation; some, as the London Companies who hold extensive property in the county of Londonderry, are always absentees from the peculiar and irremediable nature of their tenure; and some, as the Duke of Devonshire and the Earl Fitzwilliam, must either be always absentees by rotation in several districts, or constant residents in one, and constant absentees in others, in consequence of their estates being of vast extent, mutually detached, and even situated in different kingdoms. The utmost which the very best landlords of these classes can possibly do, is to adopt a liberal scale of rents, to institute a comprehensive system of improvement, to subordinate their proprietorial influence primely to their tenants' well-being and but secondarily to their own emolument, and to delegate their power of management only to such agents as shall fairly represent them on their estates, and act with kindness, probity, and paternal feeling among the people; and when such a course as this is established and pursued, it not only goes far and perhaps all lengths to indemnify the tenants for the absenteeism, but eventually tends to even the superior pecuniary advantage of the proprietors. The Duke of Devonshire, the Earl Fitzwilliam, and several of the landowner Companies of Londonderry—though constant absentees from their Irish estates—are admitted, on all hands, to be real benefactors to their tenantry and to the community at large; and they may be easily shown to have eventually lost not one farthing by their wise and benignant policy.

As a general rule, however, the frequent and even stated residence of landowners is, always in some degree, and very often in the highest degree, essential to both the prosperity of their people and the fair conservation of their estates. A tenantry, except in extraordinary circumstances, always conduct their farming operations in the best manner for both themselves and the land, when they act under the notice, and especially under the personal encouragement of their landlords. Absenteeism is often occasioned by mere caprice, love of dissipation, indifference to home, a morbid passion for change, or a roving fondness for foreign scenes and objects; it sometimes arises from no worse cause than inconsideration, or a practical ignorance of a landlord's

responsibilities to his people, and true interest in his estates; and, even when arising from circumstances which perfectly justify it or render it inevitable, it frequently is uncompensated by a system of agency sufficiently enlightened in policy and liberal in feeling;—and in all these cases, comprehending the vast majority of the multitudinous instances in which it exists, absenteeism must be pronounced an enormous evil;—it breaks up some of the most important natural connexions of society,—it withdraws from a district a large amount of the capital produced in it, or of the product of its labour, or of its only true and staminal wealth, and expends this in places with which it has little or no community of interest,—it either compels shopkeepers and artisans to struggle with the utmost discouragement and poverty, or obliges them to withdraw their useful avocations from the aid of the local farmers,—it withholds sanction from industry, countenance from honest emulation, and stimulus from zeal and enterprise,—it permits land to be maltreated, fertile soils to be scourged to exhaustion, lawns and reserved fields to be driven to waste, and enclosures, plantations, and farm-buildings to be dilapidated and destroyed,—it sets up a bewitching and powerful example of unconcern for the social good, and operates as a silent yet sure seduction to a morbid state of moral feeling,—it shows the tenant that no care is entertained for him by his superior, and teaches him, in return, to entertain little care for his inferiors,—it does him the monstrous indignity of estimating his value only by the brute force he uses in extracting produce from the soil, and in consequence either destroys his self-respect, or incites him to despise his landlord, and probably condemn all the wealthy and the educated classes of society,—it deprives him of sympathy in trouble, of assistance in difficulty, of support in momentary poverty, and of protection and guidance in a season of distress and insurrection,—it allows the local magistracy to be held by agents or underlings, throws down all hindrances to the influx of evil counsellors, and creates a powerful predisposition to lawlessness and disturbance,—and thus, if it do not provoke open outrage and unblushing vice, it will at the least nurse disaffection, deteriorate property, and convert a body of men who might have been pre-eminently and comfortably industrious into a ragged rabble of heartless sluggards. "Circumstances," remarks Mr. Martin Doyle, "may in some instances alleviate the evil; but it requires little more than the passing eye of compassion, to mark and establish the principle evinced,—on the one hand, by the order, industry, and comfort of those within the sphere of residing influence,—and on the other, by the squalid negligence, the lounging laziness, and despairing aspect of a tenantry, without a landlord to whom they might apply for counsel, encouragement, indulgence,

or relief. By this unnatural separation, the social duties are abandoned, and their connecting links, on which depends the very existence of civil life, are broken asunder." Yet no tenant, on even a bad absentee's estate, will ever fall into vice, or into sluggardliness, or even perhaps into serious difficulty, without grievous fault of his own. A landlord's failing to perform his peculiar duty, relaxes not in the slightest the moral responsibility of the tenant, but ought rather to rouse him to increased firmness in resolution and assiduity in conduct. Every tenant ought, on grounds of religion, of morality, or even of plain common sense, to make the most of his circumstances; and, if he wants the encouragements and aids of a resident and good landlord, he ought to have spirit enough to do perfectly well without them, and dignity enough to prove to all around him, that he at least—though only a poor and hard-working tenant—can live in comfort on his native soil.

ABSINTHINE. The bitter principle of the wormwood, or *Artemisia absinthium*. It has tonic virtues. See **WORMWOOD**.

ABSORBENT IN CHEMISTRY. Any substance possessing the power of receiving liquid or gaseous bodies into itself, with or without chemical action.

ABSORBENT SOILS. Such soils as most freely absorb moisture from the atmosphere. Yet though the absorbing capacity of soils is usually defined as having reference only to moisture from the atmosphere, it is equally distinct, and scarcely less important, in reference to gases from the atmosphere, and from decomposing vegetables. See articles **AERATION** and **SOILS**.

ABSORBENT SYSTEM. An intricate, minute, and wondrously ramified organism of vessels and glands in the animal structure of man and quadrupeds, for conveying into the circulation such fluids as are requisite for repairing the continual consumption of the blood. Every portion of even the more solid parts of the animal body undergoes continual progressive change, or suffers a gradual dissolution of all its existing substance, and a correspondingly gradual accession and appropriation of entirely new matter. The grand organism for repairing the constant waste and dissolution of the solid parts of the body is the circulation and deposition of the blood; and the correlative organism—or that for supplying the consequent continual consumption of the blood—is the absorbent system. This system derives its materials partly from the juices which are formed by food, and evolved out of the process of digestion,—partly from gaseous substances, received through the pores of the skin,—and partly from the melting down of such minute portions of the body as have completed their functions in the animal economy, or of such as can be spared for compensating temporary or occasional deficiencies in the quantity of the juices supplied by the digestion of food. The vessels or tubes of

the absorbent system are thin, nearly transparent, and very minute; they appear to be extremely delicate in their sides, and yet they possess comparatively great strength; they exhibit a contractile power, and have numerous valves which compel the fluids within them to flow only in one direction; and their chief or grand tubes are provided with numerous glands, or gland-like organs, which seem to elaborate some requisite change upon fluids in their progress toward deposition in the vascular system. The glands, indeed, are not very well understood; yet they obviously accomplish some important purpose in preparing the fluids for their destination; and one or more of them are concerned with every stream of absorbent fluid in the course of its passage. The glands may be seen in the mesentery of the ox or the horse, when the animal is opened; or they may be distinctly felt in the neck or under the jaw.

The tubes of the absorbent system constitute two divisions or sub-systems, called respectively the lacteals and the lymphatics. "The lacteal absorbents are situated in the mesentery and intestines, whence they draw chyle, a nutritious fluid by which the blood is nourished or augmented. The chyle is carried forward from the mesentery into a tube called the thoracic duct, which, passing up by the side of the aorta, pours its contents into the heart through the medium of the jugular vein. The lymphatic absorbents differ from the latter only in being situated over the whole body, and being the recipients of the various matters of the body; whereas the lacteals appear to absorb the chyle only." The lacteals open, by exceedingly minute mouths, on the inner surface of the stomach and intestines, and constitute the connecting organism between digestion and the supply of blood; and the lymphatics open on many interior parts of the body, and on nearly the whole of its exterior parts,—they are so intricately ramified and so exceedingly multitudinous as to defy enumeration by an anatomist,—they eventually convey their contents to the same destination as the lacteals,—and they remove the residue of nutrition, take up such portions of the body as can be spared for compensating deficient nourishment, imbibe fluids through the pores of the skin, and serve, under stimulating medicinal action, to carry off foreign or unhealthy juices in various cases of disease. In all animals, the lymphatics suffer inflammation in the vicinity of sores; and in the horse they are subject to a peculiar disorder called **FACER**: which see. "We use our power over these vessels in the horse medicinally. We stimulate the absorbents to take up diseased solutions of fluids from various parts of the body, as in watery swellings in the legs, by mercury and by friction, or by pressure in the way of bandage. When deposits are made of hard matter, or ligament, or bone, we stimulate them by blistering or by firing. It is by stimulating the absorbents, that splints and

spavins are removed. Exercise is a very powerful stimulus to absorbents; thus it is that swelled legs [swellings in the legs] are removed by half an hour's exercise. In the horse, the lymphatics are more liable to disease than the lacteals, but in man the reverse." [*Loudon's Ency. of Agr.*] Some writers give the name lymphatics to all the vessels of the absorbent system; and others distribute them into three classes or sub-systems,—vessels of the skin whose pores admit moisture into the body, vessels which drink up the chyle, and vessels which take up any extravasated fluids, and convey them into the circulation. See articles GLANDS, ABSORPTION IN ANIMALS, and LYMPHATIC VESSELS.

ABSORBENT TREATMENT. The use or administration, in veterinary medicine, of drugs for internally neutralizing acids or externally absorbing moisture. Prepared chalk and similar substances are administered for the purpose of destroying acids which lodge in the stomach and bowels, and which are originated by weak digestion; and wheat flour, calamine powder, Armenian bole, and some other dry and finely pulverized substances, are applied, in dustings between folds of the skin, in powderings upon the surface, and in other methods, for the cure of galled skin, wounds from friction, excoriations, blisters, diffused bruises, sores between the toes of dogs, foul in the foot of black cattle, foot-rot in sheep, canker in the foot of the horse, and some varieties of the disease called mange. The absorbent powders are occasionally used also as styptics to arrest hæmorrhage.

ABSORPTION IN ANIMALS. The function of absorbent vessels, by virtue of which they take up substances from without or within the body. Two great divisions have been made of this function. I. External absorption, or the absorption of composition, which obtains, from without the organs, the materials intended for their composition, and which takes place not only at the external surface of the body, but also by that of the mucous membranes of the digestive and respiratory passages. Hence, again, the division of external absorption into, 1st, cutaneous, intestinal, or digestive; and, 2d, pulmonary or respiratory. The great agents of external absorption are the veins and chyloferous vessels.—II. Internal absorption, or the absorption of decomposition, which takes up from the organs the materials that have to be replaced from the exhalants, and in which the great agents are probably the lymphatics. Internal absorption is subdivided into, 1st, molecular, nutritive, or organic absorption, which takes up from each organ the materials that constitute it, so that the decomposition is always in *equilibrium* with the deposition; 2d, the absorption of excrementitious secreted fluids, such as the fluid of the serous and synovial membranes, which are constantly exhaling, but having no external outlet, would augment indefinitely if absorption did not remove them as deposited; 3d, the absorp-

tion of a part of the excrementitious secreted fluids as they pass over the excretory passages.

ABSORPTION IN CHEMISTRY. A term variously employed to denote the property and action of certain solids and liquids to take gases into their own mass without materially altering their principal and essential characters. All solids, as soon as they acquire the requisite degree of porosity or division, exhibit the faculty of absorbing gases, but none so much as charcoal. Saussure found that, in 24 to 36 hours, one volume of boxwood charcoal absorbed—of ammonia, 90 volumes; of sulphuric acid, 65; of carbonic acid, 35; of oxygen, 9.25; of hydrogen, 1.75. The rapidity and quantity of the absorption depend on the dryness of the charcoal, its degree of porosity, the pressure of the gas to be absorbed, the temperature, the nature of the gas itself (the most easily liquefied being the most extensively absorbed), and its purity. Metals in a state of extensively fine division exhibit absorbent powers not inferior to charcoal. The absorption of gases and vapours by liquids depends on circumstances similar to absorption by solids. A liquid will of course absorb more gas, the less of the same gas it already contains. One volume of alcohol absorbed 2.60 of gas; one of ether, 2.17; of linseed oil 1.56; of water, 1.06. The specific gravity of liquids exercises much influence on the absorption, for all liquids lighter than water surpass it in absorbent power, while those heavier fall below it: yet an exact law, in this case, cannot be laid down. The volume of gas absorbed by a liquid is the same under any pressure, the temperature being constant; and the weight of gas is directly proportional to the pressure on the gas. Suppose we have 100 cubic centimeters of water, with a sufficient quantity of carbonic acid enclosed in a vessel at a temperature of 64.4° F., connected with a forcing-pump: after some time the water will have taken up 106 cubic centimeters of the gas, or 196.6 grammes. By doubling the pressure, the same bulk will be absorbed, but the weight will be 393.2 grammes; by trebling the pressure, the weight will be 589.8 grammes. On this action depends the preparation of artificial mineral waters. The reverse takes place when the pressure is diminished. Thus, if a liquid be charged at ordinary atmospheric pressure, and this pressure be lowered, a portion of gas escapes until the same volume remains in the liquid as it is capable of absorbing; or if it had been charged under high pressure, the excess escapes when the pressure is removed,—a phenomenon constantly occurring with beers, mineral waters, and other effervescing drinks. The development of heat, by the absorption of a gas, is a curious circumstance. It is generally greater in proportion to the amount and rapidity of absorption. The phenomena of chemical absorption are referred either to capillary or chemical attraction; but the subject is yet enveloped in obscurity.

ABSORPTION IN PLANTS. The process by which plants take in their nourishment. As a plant has no one organ similar to the mouth of an animal, it might seem to a superficial observer to be incapable of receiving nourishment, and was formerly regarded by even botanists as nourished by methods which were comprehensible only in theory, and could not be subjected to the test of observation. Yet leaves and flowers have always been observed to be refreshed by the access of air and moisture, and must, in consequence, be nourished by means of inhaling and absorbing; and entire plants have always been known to grow and accumulate substance when rooted in the soil, and, in consequence, must be nourished by some process of feeding through the roots. The total want of any individual organ of the nature of a mouth, simply evinces that all vegetable nourishment must be obtained in the form of gas or liquid, and received or drunk up through numerous minute stomata or pores.

The epidermis or outer bark of plants was described by some of the earlier vegetable physiologists as of so compact a texture, that no eye, even when aided by the best microscopes, could discover in it any pore or aperture; yet it was clearly discovered by the celebrated naturalists, Hedwig and De Candolle, to abound in pores; and it discloses its profusely porous character to the most common observer who uses a microscope of sufficient power. If a plant of any species of moss, so far dried as to have shrunk or shrivelled, be immersed in water, it will immediately begin to imbibe moisture, and will speedily reacquire its original plumpness and verdure; and it obviously receives the aliment which revives it, only through the medium of the pores of its epidermis.

If the bulb of a hyacinth be placed in such a manner upon a glass vessel nearly filled with water that only the lower parts of the radical fibres shall be immersed, it sends up the elements of a stem, or very evidently begins to grow, and, at the same time, occasions a perceptible diminution in the volume of the water; so that it obviously absorbs liquid through minute tubes of the radical fibres, and elaborates this into the increase of substance which constitutes its growth. All roots terminate in a greater or less number, most of them in a great multitude, and many of them in literal myriads, of minute, absorbing, drinking, spongioles, or spongelets, situated at the ends of fine, filiform, terminal, radical fibres. These countless and microscopically small organs are pulpy and bibulous, and bear the name of spongioles or spongelets, in consequence of their drinking up moisture from the soil as if they were little sponges. They consist severally of one or more central ducts or vessels, enveloped by a cellular tissue, but without any epidermis; and they constitute the grand apparatus by which plants obtain from the soil, and from its aerial, saline, and aqueous accompaniments, the chief materials of their growth and substance. A

knowledge of their existence, and of the nature and importance of their functions, explains the reason of the scientific gardener's care to preserve the extremities and minutest fibres of the roots of any choice plants which he is transplanting; it explains also the advantageousness of lifting, with as full a ball of adhering soil as possible, all such garden plants as are designed to be potted, transported to a distance, or otherwise kept alive; it shows also why damage is inflicted upon a transplanted shrub or tree by cutting away a considerable portion of its roots, or by not assigning it in its new position a soft wide bed for the easy, rapid, and extensive formation of new radicles and spongioles; and, to every gardener and farmer of ordinary reflection, it will suggest a crowd of valuable hints as to the most beneficial method of conducting hoeing, transplanting, and all other operations which affect the roots of plants.

The spongioles, it must be understood, are not distributed over the whole of a plant's roots, but are situated only at the extremities of the small, hairy radicles or fibres. All such portions of a root as possess an epidermis, or have acquired a certain degree of consistency, are destitute of spongioles; yet all the roots and rootlets fairly beneath the soil are continually lengthening and ramifying,—and, in the whole of their growth, they provide and almost clothe themselves with new series of the filiform radicles, which terminate in spongioles. Various experiments were instituted by Hales, to show the absorbing power of roots, and the force with which it acts; but as they were made chiefly on the sections of roots laid bare and immersed in water, they afforded no direct illustration of the natural action of the spongioles,—collecting nourishment at ten thousand different points, appropriating it with a nicety resembling instinct, and drinking it up in a manner and with a power akin to animal vitality. The power which the spongioles possess and exercise, in drawing liquid from the soil and pumping it into the interior of trees or of other plants, cannot be very accurately calculated; yet it has been ascertained with sufficient approximation to be distinctly understood, and to be made the subject of comparison; and, when the minuteness of the spongioles is taken into account, this power must be pronounced perfectly stupendous, and is seen to resolve itself, not into any mechanical principle, no matter how magnificent, but into the mysterious and indefinable principle of *life*.

The action of the spongioles, however, is far from being uniform in different descriptions of impregnated soil or liquid, but is materially modified by the mechanical character of the ingredients which it holds in solution. If a plant be placed in water, mixed with gum, sugar, or any other similarly viscous substance, it will absorb a larger proportion of the water itself than of the accompanying ingredient; if placed in water, mixed with any substance which does not sen-

sibly thicken it, but which exerts a noxious influence on vegetable growth, it will absorb a full proportion of the accompanying ingredient; and if placed in water mixed with a substance which very sensibly thickens it, yet which exerts a nutritive and benign influence on the vegetable economy, it will refuse to take up a fair proportion of the accompanying ingredient. Plants, for example, which are placed in water holding in solution some sulphate of copper,—a substance of very noxious character,—will absorb the liquid almost as freely as if it were pure water; plants which are placed in solutions of gum, of various proportions of thickness or viscosity, will absorb some proportion, though not a due one, of the least viscous solution,—and will absorb a less proportion of the more viscous solution,—and will absolutely perish in such solutions as are highly viscous; and plants which are placed in the drainings of dunghills, or in such waters as hold in solution or suspension the liquefied or minutely divided product of the decomposition of organic substances, absorb smaller quantities of these liquids than they would of pure water, and, at the same time, derive from them a larger proportion of the elements of nutrition and growth. The spongioles thus appear to be controlled, to a great degree, by the mechanical condition of the liquids mixed with the soil; and are probably obstructed, by various substances, especially by such as are viscous, in the pores, cells, or passages of their exceedingly minute tubes. One experimenter, however—M. Pollini—found that plants which he used absorbed different kinds of solutions without much seeming regard to their respective degrees of viscosity,—and that they absorbed more of sugar than of gum, and more of potass or of common salt than of the acetate or the nitrate of lime. This experimenter found also that, when the extremities of the roots were cut away, so as to divest a plant of its spongioles, and when the mere stumps of the roots or horizontal sections of the absorbing tubes were plunged in various solutions, absorption ceased to be modified by the same mechanical conditions as before, and took up indifferently all the kinds of salts which the several solutions contained. The spongioles of one set of plants would, in consequence, seem to be very differently organized from the spongioles of other sets of plants,—those of some more readily admitting certain substances than those of others,—those of the smaller proportion of plants affected only in a small degree by the mechanical condition of liquids,—and those of the larger proportion affected, for the most part, in a very great degree; and the spongioles, in all cases—though far more markedly in the latter cases than in the former—would seem to afford a far more qualified, hesitating, and elective admission of many substances in solution than is temporarily afforded by the horizontal sections of the absorbing tubes. A plant can live only two or three days in a solution of

sulphate of copper, but will live eight or ten days in a solution of gum; yet, as has been already stated, it absorbs comparatively much of the sulphate, and comparatively little of the gum.

The absorbing power of the leaves of plants was long a more obscure topic than the absorbing power of the roots; but it was investigated with considerable success by the naturalists, Duhamel and Marriotte, and very distinctly ascertained by the experiments of M. Bonnet of Geneva. The main object of M. Bonnet's experiments assumed that a leaf possesses an absorbing power, and sought to determine whether it exerts this power alike on both of its surfaces. "With this view," says Keith, "he placed a number of leaves over water, so as that they floated on it but were not immersed; some with the upper surface, and others with the under surface applied to the water. If the leaf retained its verdure longest with the upper surface on the water, the absorbing power of the upper surface was to be regarded as the greatest; but if it retained its verdure the longest with the under surface on the water, then the absorbing power of the under surface was to be regarded as the greatest. Some leaves were found to retain their verdure the longest when moistened by the upper surface, and some when moistened by the under surface; and some were altogether indifferent to the mode in which they were applied to the water. But the inference deducible from the whole, and deduced accordingly by Bonnet, was, that the leaves of herbs absorbed moisture chiefly by the upper surface, and the leaves of trees chiefly by the under surface. What is the cause of this singular disparity between the absorbing surfaces of the leaf of the herb, and of the tree? The physical cause might be the existence of a greater or of a smaller number of pores found in the leaves of the herb and tree respectively. The chemical cause would be the peculiar degree of affinity existing between the absorbing organs and the fluid absorbed. Duhamel seems to have been content to look to the physical cause merely, regarding the lower surface of the leaf of the tree as being endowed with the greater capacity of absorbing moisture, chiefly for the purpose of catching the ascending exhalations which must necessarily come in contact with it as they rise, but which might possibly have escaped it if absorbable only by the upper surface, owing to the increased rapidity of their ascent at an increased elevation; and regarding the upper surface of the leaf of the herb as being endowed with the greater absorbing power, owing to its low stature, and to the slow ascent of exhalations near the earth. This did not throw much light upon the subject; and the experiments were still deemed insufficient, as not representing to us the actual phenomena of vegetation, though the fact of the absorption of moisture by the surface of the leaf is fully confirmed by such phenomena." The absorbing power of the leaf, however, does not re-

quire to be proved or illustrated by experiment and argument, but is clearly evinced by three classes of facts which occur under almost every person's observation, and are perfectly intelligible to the humblest understanding,—the fall of thick vapours, the fall of rain, and the artificial watering of plants. When a fog or a heavy dew occurs after a long drought and previous to the fall of rain, drooping and sickly plants begin to revive and to resume their verdure, in the total absence of any penetration of moisture to the soil around their roots; and when gentle rain descends, or a light artificial watering is given, they in the same way exhibit obvious appearances of freshening and invigoration, before the moisture has time to affect them otherwise than through the leaves, or, at the utmost, through the epidermis of the branches and the stem. The sudden arresting of exudation or transpiration of the juices within the plant by the stopping up of the pores or stomata of the leaves, might probably be assigned by some persons as an explanation of the refreshing or revival; yet though both this, and some degree of absorption through the pores of the epidermis, may be admitted to operate, they clearly cannot possess sufficient force to produce the whole breadth of the phenomena; and the main cause must be sought, where even a careless onlooker may almost imagine himself to see it, in the absorption of the leaves.

The moisture, then, which a plant requires for its nourishment, is received partly through the pores of the epidermis of the stem, the branches, the fruit, and the hard parts of the root,—partly through the spongioles at the extremities of the radicles,—and partly through the stomata or little mouths of the leaves and the flowers. The quantity of liquid taken up from the soil, or drank in from the atmosphere, very widely varies in different conditions of the weather, at different seasons of the year, and at different stages in the life of the plant; but its varying amount seems much less closely connected with the process of absorption than with that called the ascent of the sap. See ASCENT. The quantity of liquid absorbed is much greater during the play of light and heat than during the period of darkness,—much greater during the succulency of both soil and plant than during the prevalence of aridity,—much greater in spring than in autumn,—incalculably greater in spring than in winter,—much greater during the evolution and vigour of the leaves than during their ripeness and mellowing,—and much greater during the period of the whole plant's most rapid growth than during the period of its old age and incipient decay. The vast preponderance of a very few ingredients in constituting the body or bulk of all vegetables, proves that absorption, as to the substances which it takes in, is nearly uniform throughout the vegetable kingdom; and yet the diversified action of manures, the widely different respects in which different plants exhaust the soil, and the capa-

bilities which all land possesses of bearing different plants in succession after being sickened with each preceding one in the series, evince a degree of differences in absorption of the highest importance to the purposes of cultivation.

A phenomenon, closely resembling absorption, yet so far differing from it as to be more properly termed imbibition, is exhibited by cut plants, whether soft or hard, fleshy or fibrous, but particularly the woody. When the cut extremity of the cut branch of a tree is placed in water, it drinks up, through the tissues or tubes of the wood, a sufficient quantity of water to preserve, for a considerable time, the life and freshness of the whole plant; and though it will not renew itself or maintain its own health like a root, but will alter and rot under the action of the water, yet it can again and again be artificially renewed by the simple slicing away of as much of it as alters and rots, and, at each artificial renovation, it will present an active surface to the water, and will begin to imbibe the water with nearly as refreshing an effect to the whole branch as at the beginning of the experiment. If a small shrubby plant be lifted out of the ground, and cut into three parts, respectively roots, stem, and head, each of these parts, when its lower extremities is placed in water, will drink up a certain quantity of the liquid, and the head, or branched and leafy section, will drink up the most. If the cut extremities of two cut branches of raspberry, the one free or open over its section and the other covered with wax, be placed in water, and exposed to the sun's rays, the former will imbibe one hundred and fifty grains of the liquid, while the latter will imbibe only eight; and if the one whose section is covered with wax, first have only its extremity placed in the water, and next be totally plunged or immersed, it will imbibe no more by immersion than by mere contact,—thus rendering it probable that, in some cases, absorption through the pores of the epidermis is very inconsiderable. A branch of a tree, first severed from the stem and then deprived of its own top, will imbibe water at either end,—either when placed invertedly in the water, or when placed in its upright or natural position; yet it imbibes rather more freely, and lifts the water a little higher, in the latter position than in the former.

The phenomena of imbibition are obviously those of the rooting or propagating of the woody sorts of plants by cuttings or slips. A proper cutting requires to have a clean section, that the tubes or tissue may be fully in contact with the liquid nourishment in the soil; it requires also to have one or more eyes or joints for the development of roots below the surface of the soil, and one or more for the development of leaves and branches above it; and if it be a prime cutting, it will be a twig of new wood upon a knee of older wood, so as to have the portion for development as soft as possible, and the section for

imbibition in as hard wood as possible; and its success or failure in being converted into a living and distinct plant—provided the requisite conditions as to soil, season, and situation are attended to—will entirely depend on its power of maintaining imbibition till new organs are formed. If the extremity rot before rootlets are formed, the whole cutting will perish; but if the extremity drink up nourishment till rootlets have been sufficiently evolved to succeed them in drinking it up, the cutting necessarily becomes a living plant. Imbibition, though not a strictly natural process, and though confined within limits and subject to a comparatively speedy termination, thus accomplishes, for a time, all the purposes of absorption, and even carries them out to the results of propagation.

The power of imbibition by the reversed end of a doubly cut twig is familiar to many a youth, who amuses himself with sticking pieces of willows and poplars in all sorts of ways in the ground, and observing how they will grow; and the inferiority of the power in the reversed end to that in the true end, is familiar to gardeners, who know that a cutting set in its natural position will usually develop the higher buds, while a cutting set in the reversed position will frequently develop only the lower buds. An experimenter, who doubted whether the superior imbibition by the right end of a cutting in all the instances in which vegetable physiologists had recorded it might not have been occasioned by intrinsic though unobserved superiority in the cutting itself, provided himself with two branches of willow as nearly equal to each other in every property as he could determine; and, having placed them in water, the one with its right end and the other with its inverted end in the water, he found that the inverted branch pushed its roots a little more slowly than the direct one. But wood imbibes water, not only through its tissues when transversely cut, but also through its side pores or tissues when denuded of the bark. A cut branch of willow, for example, which has all its transverse section closed up with gum mastic or with a thick coat of wax, and which is anywhere stripped of a ring of its bark about an inch in length, will, when immersed lengthwise in water, imbibe nourishment through the side tissues of its denuded portion, and will gradually form rootlets and buds, in exactly the same manner as a branch inserted in water by its free cut end.

Akin to the last of these phenomena, though essentially different from it in principle, is the hygrometric capacity of timber, or its power to take up and retain certain quantities of moisture. So great and constant is this hygrometric capacity, that every specimen of wood, when exposed to the air, will keep itself moist, and, when kept in the shade, will maintain its moisture throughout an indefinite period. A piece of wood was taken by Count Rumford from the inner part of a

beam which had been about 150 years in a building, and, on being dried by him in an oven, was found to lose about ten per cent. of its weight; and that specimen was thought by the Count to have attained the greatest degree of dryness which any piece of timber is ever capable of acquiring in the climate of France. An oaken faggot, after being exposed eighteen months to the air, and becoming as thoroughly dry as the most suitable billets of any kind for fuel, was found, on subjection to high oven heat, to lose twenty-four per cent. of its weight. Even chips of wood which have been dried in a stove to a state of complete exsiccation, will afterwards very freely imbibe water. A thoroughly dried chip of Lombardy poplar, 8 inches long, and 6 lines broad, will, if placed twenty-four hours in a room, imbibe upwards of three-fourths of a grain of moisture; a chip of thoroughly dried oak, of the same size, and in the same conditions and situation, will imbibe one grain and two-fifths; and these chips, if afterwards exposed during eight days to the open air, will not increase in weight under a continuance of the same temperature, but, on the other hand, will lose a portion of their weight if the temperature should rise. The imbibing power of wood is thus proved to be at once pervading, rapid, and retentive; and both this power in timber, and the analogous but higher power of absorption in living or standing plants, appear to co-exist with the duration of the vegetable tissues, or to be modified or destroyed only as these tissues suffer decay, distemper, or dissolution.

Another power of living plants, closely resembling that of absorption, yet so far differing from it as to be more properly termed inhalation, is the power by which they take in gaseous fluids. The atmosphere, as we shall see in some future articles, has quite as much to do as soil and water with the nourishing of plants; and in particular, it furnishes matter for the formation of a very large proportion of the bulk or substance of them all in the form of carbonic acid gas, and matter for the formation of a considerable and very valuable proportion of the substance of many in the form of nitrogenous or ammoniacal gases. Since water and other non-elastic fluids have been proved to penetrate leaves, roots, and epidermis, no difficulty can exist in understanding that gases may penetrate them with equal or even superior facility. "It might be asked, however," observes Keith, "whether the water and the gases enter by the same pores, where pores are found to exist. But though there appears to be nothing absurd in the assertion of the affirmative, yet it seems probable that each has its own peculiar pores or stomata. At least, it is known that some surfaces which repel moisture exhibit no evidence leading us to suppose that they repel the common air. This is well exemplified in the case of cabbage leaves, in the time of rains and dews, when the drops roll

along the upper surface of the leaf without wetting it, or lodge in its folds like globules of quicksilver. So also in the case of fruits covered with bloom. It is probable, therefore, that all such leaves and vegetable surfaces as repel moisture are fitted rather for the inhalation of air, which they have long been regarded as capable of effecting; and in times in which it was fashionable to look for analogies between the plant and animal, in everything whatever, leaves were even regarded as being the lungs of plants. Grew thought he had discovered in the leaves a number of little bags or bladders filled with air. The air was supposed to have entered by inhalation, and the bags or bladders were supposed to be analogous in their function to the cells of the lungs of animals. M. Papin introduced into the receiver of an air-pump an entire plant, root, stem, and leaf; but the consequence was that it very soon died. He then introduced a plant by the root and stem only, the leaves being still exposed to the influence of the air. The plant lived for a considerable length of time, and hence he concluded that leaves are lungs. But these facts are far from being sufficient to settle the point in question, and we introduce them, not so much with a view to show their inadequacy, as to show that the doctrine, even if founded in truth, could not have been satisfactorily demonstrated by any experiments that were practicable at that time. It is to the modern improvements in pneumatic chemistry, and to them alone, that we are indebted for our knowledge of the real functions of the leaves of plants, and of their analogical resemblance to the lungs of animals; it being now proved indisputably that the leaves of plants not only contain air, but do both inhale and respire it. It was the opinion of Priestley that they inhale it chiefly by their upper surface; and it has been shown by Saussure that their inhaling power depends entirely upon the integrity of their organization. A bough of *Cactus opuntia*, detached from the plant, and placed in an atmosphere of common air, inhaled in the course of a night four cubic inches of oxygen; but when placed in a similar atmosphere, after being cut to pieces and pounded in a mortar, no inhalation took place."

M. Adolphe Brongniart, in a memoir upon the structure of leaves, and on their relation with the respiration of vegetables in air and water, read before the Academy of Sciences in Paris, in 1830, states that the leaves of plants that live in the air have a totally different structure from those that are completely submerged, and that this difference in the structure of organs is in direct relation to the two particular functions of leaves, respiration and transpiration. In leaves exposed to air, the surface of the leaf is covered by an epidermis of uncertain thickness, formed of one or more layers of colourless cellules, closely packed together. This membrane is pierced with the pores usually known by the name of stomata.

The doubts that have been entertained upon the existence of perforations in these stomata, M. Brongniart thinks he has removed, and that it is certain that in the centre of each stoma is an opening by which the outer air communicates with the parenchyma. This parenchyma is evidently the seat of respiration; for it is the part that changes colour in exercising this function, which becomes green by the absorption of the carbon of the carbonic acid of the atmosphere, and which is discoloured again in darkness by the combination of the carbon of its juices with the oxygen of the air. This parenchyma differs entirely from that of other organs by the numerous irregular cavities that it contains, which communicate with each other and the outer air by means of the openings of the stomata. It is into these cavities in the cavernous parenchyma of aerial leaves that the atmospheric air penetrates when it is absorbed by the surface of the utricles of the parenchyma, that are distended with the fluids which seem to nourish the plant. According to M. Brongniart, aquatic leaves, if submerged, differ, in being completely destitute of epidermis. It is not alone stomata that they want, as has long been known, but the epidermis also, having no need of protection from rapid evaporation. There are none of the cavities that abound in the parenchyma of aerial leaves, but, on the contrary, the cellules of the tissue are compactly fastened together without any interstice, and the air dissolved in the water can only act on their outer surface. For this reason the proportion borne by this surface to the whole mass of the leaf is unusually great; the leaves, from want of epidermis, dry up quickly when exposed to the air, and can only exist in water or a very humid atmosphere. Hence the author concludes that the epidermis is destined to protect aerial leaves against too rapid evaporation, and the stomata or pores of this epidermis become necessary to maintain a communication between the atmosphere and the parenchyma.

The existence of pores, even in the minute orifices called stomata, is questioned by some very distinguished botanists; and the existence of stomata themselves is seldom detected in the epidermis of roots, bulbs, flowers, and fleshy fruits which require free exposure to the air, or at least a free infiltration of it, in order to their continuing healthy or arriving at maturity. Some recent experimenters and physiologists, however, have attempted to prove that gases may be inhaled and moisture imbibed, through either the vegetable or the animal membrane, without the intervention of any visible pores,—or that gases may be inhaled and moisture imbibed, by either an exceedingly powerful organic infiltration of the molecules or incomprehensibly small ultimate atoms of matter, or by the inward rush of a less dense to a more dense fluid, excited by electricity. But further explanation on this point will be given in the articles *EXDOSMOSE* and *ASCENT OF*

SAP; and elucidations of other departments of vegetable physiology will be given in numerous articles,—particularly those on AERATION, ANATOMY OF PLANTS, BLEEDING, CAMBIUM, CELLULAR TISSUE, DECAY, ELABORATION, EXCITABILITY, FERTILIZATION, GERMINATION, IRRITABILITY, LEAF, LIFE, MORPHOLOGY, PHYTOLOGY, PITH, POLLEN, REGENERATION, ROOT, SAP, SEXUALITY, SLEEP, SPIRAL VESSELS, STEM, SUSCEPTIBILITY, and VASCULAR ORGANS.—*Duhamel, Physique des Arbres*, 1758.—*Bonnet, Recherches sur l'usage des Feuilles dans les Plantes*.—*Darwin's Phytologia*.—*Saussure, Recherches chimique sur la Végétation*, 1804.—*Keith*.—*Knight*.—*Ellis*.—*Memoir by M. A. Brongniart in the Annales des Sciences*, for December, 1830.—*Daubeny's Memoir on the degree of selection exercised by Plants with regard to the earthy constituents presented to their absorbing surfaces*. Printed in the *Linnean Society's Transactions* for 1833.

ABSTERGENTS. Medicines or medicinal applications which clear away impurities from the animal system. They chiefly consist of saponaceous and stimulating applications for the reduction and removal of tumours and concretions from the joints and other parts of animals.

ABSTINENCE. The temporary privation of an animal's food or drink. The necessity for a supply of food is felt by all animals, yet it is not experienced in an equal degree by all species, nor by animals of the same species, nor even by the same animal when placed in different circumstances. The appetite for food is heightened by youth, fatigue, long-continued want of sleep, by violent passions when the paroxysm has passed, by convalescence after a long illness, by a dry and cold air, and by the influence of climates and seasons. On the other hand, old age, prolonged sleep, hybernation, perfect repose, and hot baths, diminish the necessity for food. With the human species, luxurious habits lead to a loss of appetite, while it is heightened by labour; and thus hunger, which declines the invitation of the opulent epicure, comes an unwelcome guest into the hovels of the destitute.

There is a wide difference between the faculty of existing on a given portion of food, however small, and under the total privation of it. Neither is it to be overlooked, in considering this subject, that, in certain situations, the animal functions are feebly maintained. Numerous animals are destined to pass a large portion of their existence in a state of absolute insensibility. On the simple approach of cold, without any other known cause, they become languid and inactive; their members stiffen; and they fall into a profound torpidity, from which they are only to be aroused by augmenting the surrounding temperature. But not to recur to such instances, where the animal functions are unquestionably impaired, we have witnessed many cases of beasts, birds, fishes, and insects, living incredibly long in a condition of total abstinence; and even some human beings, who, of all animals, can least support the want of

sustenance, have survived in a similar situation.

More than a century ago, it was observed by the Italian naturalist Redi, that animals do not perish from hunger so soon as is commonly believed. A civet-cat lived ten days with him; wild pigeons, twelve and thirteen; an antelope, twenty; and a very large wild cat, the same time, without food. A royal eagle survived twenty-eight days; and Buffon mentions one that lived five weeks without food; a badger lived a month; and several dogs, thirty-six days. We have accounts still more surprising, from naturalists of undoubted credit. A crocodile will live two months wanting food. Leeuwenhoek had a scorpion that lived three months. Redi kept aameleon eight months in a state of perfect abstinence, and vipers, ten. Vaillant had a spider that lived the same time; nay, its strength was then sufficient to kill another of its own species, as large as itself, and quite vigorous, when put under the receiver where it was kept. According to several authors, some of those animals that have long supported the privation of food, did not become nearly so much emaciated as might reasonably be supposed. Mr. John Hunter enclosed a toad between two stone flower-pots; and, at the end of fourteen months, it was as lively as ever. M. Sue quotes instances of the same animals living eighteen months, without either food or respiration, from being sealed up in boxes. M. Herissant covered a box, containing three toads, with a coating of plaster. On opening it eighteen months afterwards, one was still alive. Land tortoises lived eighteen months with Redi; and Baker kept a beetle without food three complete years, when it escaped. Dr. Shaw mentions two Egyptian serpents that had been preserved for the period of five years, wanting sustenance, in a bottle closely corked; yet, when he saw them, they had cast their skins, and were as lively as if newly caught.

In general, the carnivorous animals endure a long-continued fast with less inconvenience than the herbivorous. This remark must not be confined to mammalia, for it extends to the birds of prey, especially to the eagle, to serpents, and spiders, all which animals can remain a very long time without food, and do not appear to suffer from their continued abstinence. On this account they are in general of a more meagre habit of body than such animals as live either on herbs or fruits. There are many instances on record of old men, but more especially of women, who have lived for several weeks, some say months, without food. A mad enthusiast, who imagined himself to be Christ in person, remained, it is said, during the forty days of Lent without using any food whatever; but confined himself, without swallowing any thing, merely to washing his mouth with water or wine. These instances are not, however, always very well authenticated; and it would be difficult to prove, in this case,

that the fanatic did not actually swallow some of the fluid. Moisture, darkness, and repose, tend to diminish the usual effects of abstinence. A dog has remained alive under these circumstances for nearly fifty days without food. Persons of a vivid imagination, as well as frantic madmen, have in general a digestion extremely energetic, and they sometimes consume enormous quantities of food. Idiots also are frequently tormented with a devouring hunger. Next to sleep, which wholly suppresses this appetite for the time, nothing tends more to drive away hunger in man than the long-continued exercise of deep thought.

There are some surprising instances of the power of animals to survive long under the privation of sustenance; and others occur, which are beyond the possibility of deception, such as a decapitated snail, which, though deprived of the very organs for taking food, will not only live months, perhaps years, but will acquire a new head, similar to that of which it was deprived. The state of an animal, living in the air without sustenance, is, in the general case, very different from one living without it in water. In this fluid, we have seen many of the smaller animals survive a long time, without any other support than what the simple element afforded. Hydrachnæ have been kept eighteen months without any supply of food; and leeches, as well as certain species of fishes, above three years. Still these instances are not to be compared to those in which the privation of food is absolute; because it is difficult to ascertain whether imperceptible animalculæ might not be the food of such animals. It has been thought, indeed, that living creatures may increase in size, without any nutriment supplied; and it is certain, though the point may probably be explained on different principles, that the animated form will unfold by the simple application of heat alone; and after it has burst its integuments, that it will increase its size. Thus, the eggs of fishes, snails, and other aquatic animals, will be hatched, and their young attain considerable size, in nothing but water. Vipers also, if taken when just produced by the mother, will grow much larger, though supplied with nothing but air. See articles HYBERNATION and NUTRITION.—*Redi's Osservazioni agli Animali Viventi, che si trovano negli Animali viventi.*—*Buffon's Histoire Naturelle.*—*Virey sur les Vers.*—*Sue sur la Vitalité.*—*Muller's Hydrachnæ.*—*Hunter on the Animal Economy.*—*Phil. Trans.* vol. xiv. p. 577.—*Id.* 1741, vol. xli. p. 725.—*Mem. Acad. Par.* 1731.—*Comment. Bonnon.* tom. ii. p. 221.

ABVACUATION. The very copious drawing off or evacuation of any fluid, particularly blood, from the animal system.

ACACIA. A very extensive and singularly beautiful genus of small trees or shrubby plants of the pea tribe. The generic name is supposed to be the Greek name of some plant of the genus, and was first taken by Willdenow, in his revision of the genus *Mimosa* as the designation of one of

his new divisions. They inhabit chiefly the tropical countries of the old world and of America; yet they extend, in a few instances, within the temperate zones,—they abound throughout both the mainland and the subordinate islands of Australia,—and, in several instances, they are general and favourite objects of tender cultivation in Great Britain. Some of the species produce gum-arabic and catechu; two or three other species produce tannin,—or the principle by which skins are converted into leather; and most are remarkable for the gracefulness of their form, the elegance of their foliage, and the surpassing brilliance and beauty of their flowers. Nearly three hundred species are known to botanists; but only about eighty-five appear to have come under the notice of British gardeners. The species which at present challenge most attention, for their superior beauty, or for the novelty of their introduction, are those bearing the botanical designations which we shall here mention in a note.* About two-thirds of the whole genus have true leaves, pinnated, or winged with series of leaflets in pairs—some twice or thrice pinnated—and all spread out horizontally, with leaflets, smooth, small, and in multitudes; and the other third, when in a perfect state, have, in lieu of true leaves, enlarged and expanded leaf-stalks, which maintain a somewhat vertical position, and probably perform the same functions as leaves. The appearance of the two divisions or sub-genera is, in consequence, widely different,—that of the greater division being distinguished by an absolute profusion of leaflets in the pinnate arrangement, and that of the lesser division exhibiting the solemn baldness and majestic simplicity of long, flattened, upright, leafless pedicles.

The *Acacia catechu*—one of the most prominent species of the greater division, and that which yields one of the kinds of catechu or *Terra Japonica* sold in our shops—is, in the East Indies, a tree of rather high and strong stem, with leaves in ten divisions, linear and downy leaflets in from forty to fifty couples, flowers in cylindrical spikes, growing two or three together, and flat, narrow, oval pods of from two to three inches in length. The *Acacia Arabica*—another of the best known species of the greater division, and that which yields the best gum-arabic of commerce—is, in the East Indies, in Arabia, and in Abyssinia, a tree of about fourteen feet in height, inelegant in appearance, and carrying long, curved, beaded-

* *Acacia alata, brevifolia, biflora, Cunninghamia, dealbata, decora, discolor, glaucescens, diptera-erip-tera, homomalla, Juavara, Julibrissin, longifolia, longissima, micracantha, obovata, pendula, pentadenia, platyptera, polymorpha, pubescens, rotundifolia, spectabilis, vestita, affinis, cyclops, dentifera, diffusa, hastulata, pulchella, saligna, subcærulea, cuneata, cyanophylla, Farnesiana, gummifera, latifolia, Libbeck, nilotica, Riceana, Segal, Sophora, stricta, armata, floribunda, heterophylla, lophantha, curvifolia, decurrens, horrida, linifolia, verticillata, and undulofolia.*

looking pods, with deep contractions or compressions between their seeds. The *Acacia pubescens* or the downy acacia—also belonging to the greater sub-genus, and a native of New Holland—has leaves in from three to ten divisions, linear and very narrow leaflets in from six to eighteen couples, and stalked, globose, long racemes of yellow flowers; and is one of the most graceful and elaborately elegant hothouse plants of Great Britain. The *Acacia Julibrissin* or silk-tassel acacia—likewise a species of the greater sub-genus, and a native of Persia and some countries upon the Mediterranean—has leaves in from eight to twelve divisions, elongated and sharpened leaflets in about thirty couples, and magnificent clusters of lilac or rose-coloured flowers, arranged in a form which partakes of both the corymb and the panicle; it natively grows to be a tree of exquisite beauty, and flings up from its flowers long and slender stamens which stream in the breeze and glitter in the sunshine like tassels of silk; and, in the extreme south of England, when trained against walls with a southern aspect, and cultivated with ordinary care, it thrives to perfection, and constitutes one of the richest ornaments of either a landowner's or a gentleman-farmer's taste and care. The *Acacia Sophora* or fragrant acacia—one of the species of the smaller or leafless division, and a native of Australia—has narrow, tapering leaf-stalks, dense and slender racemes of flowers, and long, curved, tapering seed-pods; and, as cultivated in Great Britain, it forms a noble ornament to the green-house, or occasionally to the open border, and displays numerous heads of flowers during all the early months of the year. The *Acacia longifolia* or long-leaved acacia—also one of the species of the smaller division of acacias, yet ranked by some botanists among the mimosæ, and called *Mimosa longifolia*—has long, narrow, lance-shaped leaf-stalks, bears axillary spikes of flowers on short flower-stalks, grows well, in the south of England, in the open border of conservatories, attains there a height of from 12 to 14 feet, and bears a profusion of odoriferous flowers during nine or ten weeks of spring and summer. The superb and very numerous genus of acacia plants may be tolerably well understood from these specimens; and it possesses interest to the farmer—not alone as an object of garden cultivation or of instructive curiosity—but for its close relationship, in some particulars, to the various leguminous plants which constitute so large a portion of the crops raised upon his fields. The acacias are best propagated in this country from cuttings. The young wood should be taken off at a joint, and planted in a pot of sand under a bell-glass. They may also be propagated from the root, by planting pieces in a light soil, leaving the top a little exposed, and placing the pots in a hot-bed. The best soil for this class of plants is a mixture of sandy loam and peat.

ACACIA-TREE, or LOCUST-TREE, or FALSE-

ACACIA—botanically, *Robinia*. A beautiful genus of hardy trees of the pea tribe. They have pinnate leaves, and bear nodding racemes of white or rose-coloured flowers; and, in general appearance, they occupy a sort of middle place between the mountain-ash and the larger division of the true acacia. The genus *Robinia* formerly included the species which now constitute the genus *Caragana* or Siberian pea-tree; and it is distinguished from these species by the unequally pinnate form of its leaves, and the long, gibbous character of its legumes. The known species at present belonging to it are designated, *Pseud-acacia*, *amorphæfolia*, *crispa*, *microphylla*, *procera*, *sophoræfolia*, *spectabilis*, *tortuosa*, *echinata*, *floribunda*, *formosissima*, *dubia*, *inermis*, *hispidæ*, and *viscosa*; and the most marked varieties or sub-species are designated *longifolia*, *rubra*, *major*, *alba*, *gracilis*, *heterophylla*, and *pyramidalis*,—the first of these varieties belonging to the species *Tortuosa*, the second to *Inermis*, the third to *Hispidæ*, the fourth to *Viscosa*, and the three others to *Pseud-acacia*. A number of other varieties, or at least acacia-trees with other names, are sold in the nurseries, and even advertised as distinct species; but they possess no permanent or real characteristics, and are altogether unworthy of notice.

By far the best known of the species, and that which will serve to illustrate all the others, is the *pseud-acacia*. It is a native of America; its seeds were first brought to Europe, from Canada, by M. Jean Robin, nurseryman to the king of France, and author of a work entitled a 'History of Plants;' it was first grown, in the Jardin des Plantes at Paris, by Vespasien Robin, the son of Jean Robin; and it took its botanical name of *Robinia* from these its introducers, and afterwards communicated that name to the whole of the genus. It was supposed by early British missionaries in America to be identical with a tree which grows in Asia, and which is believed to have nourished the locusts mentioned in scripture; and, in consequence, was designated by them the locust-tree. It occurs in Lower and Upper Canada, and in both the eastern and the western states of North America, and grows in great abundance in the south-western states, particularly in the valleys of the Alleghany mountains; and it was one of the earliest of the valuable and exceedingly numerous contributions from America to the woods and shrubberies of Europe. Its history, since its introduction, has been curious and singularly fluctuating; for the tree has at one time been utterly neglected, and at another propagated with almost the zeal of a mania,—at one time extolled for numerous and superlative excellencies, and at another denounced for insufferable and manifold worthlessness. The English gardeners very early obtained seeds of it from Virginia, and propagated it with considerable interest. Parkinson mentions it in his 'Theatre of Plants,' published in 1640; and says that it was grown to a great height by John Tradescant; and Evelyn notices it in his

Sylva, presented to the Royal Society in 1662, and recommends it as an eminently ornamental tree for shaded walks and avenues. Bradley, who wrote in 1720, appears to speak of it as in his time a very rare or neglected plant; and Mortimer, who wrote a little later, states that many trees of it had been planted in St. James' Park, and had been condemned to the axe in consequence of becoming shattered and unsightly by the force of storms. Its diffusion throughout France seems to have been always steady and rapid, and has at last rendered the tree everywhere as common as an indigenous plant, and both a characteristic and a very beautiful feature of close landscapes; and its diffusion throughout Great Britain has at length become somewhat general, yet not such as to make it much known beyond the precincts of gentlemen's pleasure-grounds, or the plots of suburban villas. Many noble specimens of it occur along the banks of the Thames; some remarkably fine trees, apparently of great comparative age, grow on the Duke of Devonshire's grounds around Chiswick House; many old trees, and several imposing groups, grow in the parks of Sion House; some of the finest specimens in England occur on the estate of Claremont in Surrey; some trees, of seven or eight feet in girth at two feet from the ground, may be seen in Claremont parks; some trees, of eight feet in girth at three feet from the ground, may be seen around Sir William Cooper's seat of Isleworth House; many very fine trees grow in parks and shrubberies in the vicinity of Edinburgh; one of the finest groups anywhere to be seen grows at Niddry-Marshall, in Mid-Lothian; and many handsome and imposing specimens occur in the neighbourhood of Dublin. A greater proportional quantity of the acacia-tree seems to grow in Middlesex and Surrey than in any other British counties, yet even there the tree is confined chiefly to the lawn and the shrubbery; it grows exceedingly well in many parts of Scotland, and forms a decidedly marked feature in the *sylva* around the Scottish metropolis; it grows more rapidly in Ireland than in either England or Scotland; and it becomes an exquisitely ornamental tree, attains a good height, and firmly resists the rigours of winter, throughout many parts of Germany.

The acacia-tree, in consequence of its having large, spreading, decurrent roots, was at one time thought to be a very suitable tree for planting along the margins of canals and rivers, to bind the soil, and give a firm texture to the ground; and, in consequence of its sending up a profusion of young shoots, for which cattle show a great fondness, it was more recently recommended for cultivation as forage. In 1823, Cobbett, in his widely circulated publications, strongly urged stock farmers to adopt it; he praised its virtues with astonishing zeal, and in altogether extravagant language; and, to prove that his own faith in it was sincere, and his solicitude for its pro-

pagation disinterested, he imported immense quantities of its seeds from America, and distributed in Great Britain upwards of a million of plants. But the enthusiasm for the acacia-tree as a pet plant for farmers has passed away, and—as well as an extolling of its superior fitness for various purposes in the arts—has proved to be, in a chief measure, unfounded.

The acacia-tree very commonly grows to the height of from 35 to 45 feet. Its branches are covered with a smooth, purplish-coloured bark, and armed with strong crooked spines or thorns at the buds. Each bud, especially in young and vigorous shoots, is usually guarded by two spines, situated on opposite sides. The branches, especially in young trees, are very brittle; and, in summer, when power is given to the wind by the foliage, they often break off during storms. Yet the tree, if afforded the shelter of other growing timber in its youth, grows steadily up without fracture, and eventually becomes as stately and apparently firm as any other tree of naturally slender proportions; and had its tendency to consolidation in age been formerly known, it would have found its way more steadily into general favour, and not have been condemned on account of its inability to resist storms in exposed situations. The leaves do not exfoliate till late in spring; but they amply compensate for their lateness by their exceeding elegance and beauty. The leaves are large, and are pinnated or winged with eight or ten pairs of fine, green, stalkless leaflets, and terminate in a point formed by an odd and transverse leaflet. The flowers appear in June; they consist of long, pendulous bunches, hanging down like those of the well-known *laburnum*; they have the papilionaceous or pea-blossom form, and in general are white, but in one variety are of a rose colour; and “when the tree blows freely, its head will be enchantingly covered with them, for they will hang all over it in a free and easy manner, some bunches appearing wholly in view, others again half-hid by the waving leaves that will sometimes alternately hide and show them.” The flowers are also gratefully odoriferous; and, though short-lived, they compensate the brevity of their existence by the reminiscences which they create of both their beauty and their fragrance. The legumes or seed-pods are flat, oblong, and one-celled, and the seeds are of a rusty colour and kidney-shaped outline, and terminate like a hooked beak.

The acacia-tree, through all its stages, but particularly when young, grows with great rapidity. A plant raised from seed will usually, in a few years, attain a height of eight or ten feet; and a shoot from an old stool, or from a vigorous tree of middle age, will often, in a single season, grow to a similar height. In favourable situations in Great Britain, it will, in the course of 40 years, attain a height of 60 feet with a girth of six feet at the height of three feet from the ground; and almost everywhere in America, it attains, in the

same period, a height of from 70 to 80 feet. No other trees grow more rapidly than this, excepting some species of the willow and the poplar. In the arboretum of the Horticultural Society of London—which was formed with the express design of introducing all available exotic trees, and of ascertaining their relative values and their respective habits—the acacia-tree was planted as an individual of a great and splendid and very diversified collection; and, after a period of about twelve years, it was found to have grown better than either oak, ash, elm, maple, or any other hard-timber within the walls. An instance occurred at Chiswick of a strong shoot or sucker being staked for its protection and assistance, and of its attaining, in a single season, the extraordinary height of 20 feet, with a circumference of three inches. The suckers of the tree are few and infrequent when it stands isolated and exposed, and numerous and frequent when it stands in a shrubbery or wood; they rise, not in masses or in groups or with slender and attenuated form, but in single stems and with bold outline and vigorous growth; they soar up, even in the most sheltered or umbrageous situation, to the height of from twelve to fifteen feet in one season; and so long as they are permitted to remain attached to the root-bud whence they sprang below the ground, they very rarely suffer displacement or any other serious accident. When a full-grown tree is felled, numerous suckers start up everywhere from its roots, with the same freedom and power as if a new plantation had been carefully made; so that a succession of either single trees upon the lawn, or of a group of trees in a clump or grove, is obtained with the utmost possible cheapness and facility.

The acacia-tree will grow well upon almost any soil, but it prefers a rather rich sandy loam, and succeeds best in the deep, fine soil of a properly prepared garden. It may be propagated either by cuttings, by suckers, or by seeds, but flourishes most when raised by the last of these methods. The seeds do not preserve their vitality more than two years; and such as are sown ought always to be from America, as those of plants in Europe seldom acquire full ripeness. The seeds should be sown, about the end of March or the beginning of April, in a bed of light earth; they will send the young stem to the surface about six weeks after they are sown; and the seedlings may be transplanted, in the following summer, into their final situation; but they ought rather, when a twelvemonth old, to be transplanted into a nursery-ground, in rows at distances of $1\frac{1}{2}$ foot and 3 feet, and allowed to remain there during two years. No plant, however, should be longer out of its final situation than three years after the sowing of the seed; for if lifted at a more advanced period, it will have unmanageably long, tough roots; and as it must be divested of a portion of these, it will be seriously enfeebled, and perhaps absolutely killed.

The acacia-tree, as grown in Great Britain, is almost always too profuse in its branches and too slender in its stem, to be serviceable for any purpose as timber; but, as grown in America, it has long been known to furnish a very hard, durable, and useful wood. It is sent in large quantities from America to Great Britain, and especially to Plymouth, to be used for trenails or fastening belts in ship-building; and in America itself, it is extensively used for posts, and is sometimes found sufficiently large to be employed as timber in the construction of ships. Its tendency, at all ages, to ramify itself in numerous branches, unfits it to be used, as recommended by Cobbett, for hop-poles; and its general character renders it more or less unsuitable for most of the numerous purposes for which it has been recommended, excepting the tasteful ones of ornamenting hedges, lawns, shrubberies, and villa-grounds. Yet the following uses of it mentioned by our contemporary, C. W. Johnson, Esq., and by other writers, deserve attention;—the wheel-wright and the coach-builder have employed it for axle-trees of carriages; the turner has used it for various purposes of his art, and has been delighted with its smooth texture and beautifully delicate straw colour; fence-makers have used it for rail-fencing, and have found it to stand wet and dry near the ground better than any other timber in common use, and to be as durable as cedar; landscape gardeners have planted it for a combination of ornament and utility, and have found its shade to encourage the growth of grass; and farmers might try it for the formation of hedges, and, were they to transplant it from the nursery when it has a height of about four feet, they would find it forming a hedge quite equal in compactness, strength, economy, and manageableness to hedges consisting of some tried and approved plants,—and a hedge available as a fence far earlier than any other, and capable of being raised to the very greatest desirable elevation. The flowers of the acacia-tree, we may state in conclusion, are used in St. Domingo for making a distilled liquor; and its roots and leaves and juices contain a considerable proportion of sugar.

The species of *Robinia* called the Rose acacia—botanically, *Robinia hispida*—is a remarkably beautiful shrub, much smaller than the *Robinia pseud-acacia*, and attaining an extreme height, in favourable situations, in its native region, Carolina, of about twenty feet. A sort of prickly hairs cover its young branches, and the footstalks and cups of its flowers; and occasion it to be called *hispida* or hairy. Its flowers bloom in June, and frequently again in July and August; and they are large, odourless, of a beautiful rose-colour, and of very handsome appearance. Its shoots of each year, or newest and freshest twigs, carry the flowers; so that its old wood may be annually pruned away to any extent which the taste of the cultivator or the situation of the plants may require. The Rose acacia thrives best in a rich

soil. From its brittleness it is easily injured, especially when grafted above the surface of the ground: a preferable mode, therefore, for dwarfs, is to graft them on the root, or under the soil, or to train them to a wall.—*Loudon's Gardener's Magazine*, vol. xvi.—*Hunter's Georgical Essays*, vol. iv.—*Miller's Gardener's Dictionary*.—*Marshall on Planting*.—*The Penny Cyclopædia*.—*Johnson's Farmer's Encyclopædia*.—*Dictionnaire D'Histoire Naturelle*. Paris, 1816, Tome I.—*Maund's Botanic Garden*.

ACACIA (THREE THORNED). See GLEDITCHIA.

ACALYPHA. A numerous genus of uninteresting plants of the euphorbia tribe. The species amount to upwards of forty; they are natives variously of North America, Jamaica, the Caraccas, the East Indies, and China; some are stove plants, and several are hardy annuals; and those best known have a considerable resemblance to the common nettle.

ACANTHA. The prickly of a thorny plant; and, by a figure of speech, anything pointed in the manner of a thorn.

ACANTHACEOUS PLANTS. Thistles, hawthorns, briars, and all other plants which are armed with prickles, thorns, or spikes. But the Acanthaceæ, in the systematic or botanic sense, are merely one natural order of plants with one-petalled flowers; they are almost all herbaceous, or only in a slight degree shrubby; and most of them are found only within the tropics, and may be regarded as there corresponding to the mints, sages, thymes, and deadnettles of Europe.

ACANTHUS. An herb with broad, prickly leaves, which gives both name and form to the imitation-foilage or architectural decoration on the capital of a Corinthian pillar. Both this plant, which is botanically called *Acanthus spinosus*, and another, which is called *Acanthus mollis*, and which has sometimes been regarded also as the model of the Corinthian capital, are cultivated in the gardens of Great Britain, but require protection from severe frost. The acanthus is a genus of plants, having these two as its best known species, but including about a dozen other species, and serving as the type of the acanthaceous order. The generic name is derived from the Greek, and signifies a spine. The *Acanthus mollis* is named in old pharmacopœias Brankursine. Its leaves and roots have emollient and demulcent qualities. It should remain undisturbed in the shrubbery for several years, when it will throw up strong undivided stems of flowers.

A'CARI. Minute insects which form, feed upon, and propagate scab in sheep and mange in horses, and of which one or other species are known to infest almost every tribe of the animal kingdom. Though no larger than the hole formed by the point of a fine pin, they burrow under the skin, irritate the flesh below it, and travel from place to place on the body, extending their devastations. "If one or more female acari," says M. Walz, "are placed on the wool of a sound sheep, they quickly

travel to the root of it, and bury themselves in the skin, the place at which they penetrate being scarcely visible, or only distinguished by a minute red point. On the tenth or twelfth day, a little swelling may be detected with the finger, and the skin changes its colour, and has a greenish blue tint. The pustule is now rapidly formed, and about the sixteenth day breaks, and the mothers again appear, with their little ones attached to their feet, and covered by a portion of the shell of the egg—from which they have just escaped. These little ones immediately set to work, and penetrate the neighbouring skin, and bury themselves beneath it, and find their proper nourishment, and grow and propagate, until the poor animal has myriads of them to prey on him and to torment him, and it is not wonderful that he should speedily sink. Some of the male acari were placed on the sound skin of a sheep, and they, too, burrowed their way, and disappeared for a while, and the pustule in due time arose; but the itching and the scab soon disappeared without the employment of any remedy." Both sexes of the insect are present when the disease is propagated. The female appears to be very prolific, producing from eight to fifteen in a litter. Though most of the insects perish before the severity of winter, yet some survive it, and occasionally recommence their devastations in spring. See article SOAP.

The *Acarus scabiei*, or *Sarcoptes hominis*, generally exists on all persons affected with itch who have not commenced a course of medicine. It is almost entirely confined to the hands, where it is found beneath the epidermis, but is also sometimes met with on the feet, in the arm-pits, and other places. It is never found on persons affected with any other cutaneous disease than itch. The insects are all destroyed after the sulphuro-alkaline ointment has been applied; but the patient may not be still cured, for the eruption may remain, unless it be properly treated. Insects removed from an affected to a sound person, multiply on the skin of the latter, when presently the eruption appears. M. Gras several times communicated the disease in this manner; once, at the desire of Dr. Pariset, secretary of the Académie de Médecine, when it produced a sanatory revulsion in a young girl who had fallen into a state of stupor. On the other hand, he several times tried to inoculate himself with the serum of the itch vesicles, but without success. He therefore concludes that the sarcoptes is the sole agent in producing the contagion of itch, which is not contracted unless that animal or its eggs adhere to the skin or clothes of persons coming into contact with those having the disease. The number of insects on a person has no relation to the extent and intensity of the eruption; for sometimes not more than five or six are found on individuals covered with vesicles and pustules; and again, a hundred have been taken from the hands of a person, who yet had only a few vesicles.

Some of the acari species, particularly the red spider, are extremely noxious to the gardener and floriculturist. A correspondent of the 'Gardeners' Gazette' writes:—"In all the recipes for destroying acari which I have seen, sulphur is an ingredient; this, in its crude state, will not unite with the liquids used for that purpose, and therefore it can have little or no effect, except when applied as a wash on the heated flues of a house. In order to make it unite with soapsuds, tobacco water, and other liquids usually made use of for destroying insects, it must be converted into a sulphuret, by boiling it with lime or an alkaline salt, as in the following mixture, which expeditiously and effectually destroys the red spider, by merely immersing the plant, or part infested, in the mixture. Common soft soap half an ounce, sulphuret of lime one ounce by measure (or two tablespoonfuls), soft water (hot) one ale quart. The soap and sulphuret to be first well mixed with an iron or wooden spoon, in the same manner as a mixture of egg and oil is made for a salad; the hot-water is then to be added by degrees, stirring the mixture well with a painter's brush, as in making a lather, by which means an uniform fluid will be obtained like whey, without any sediment, which may be used as soon as it is cool enough to bear the hand in it. This mixture will destroy every insect usually found in the greenhouse, by mere immersion, except the coccus, or scaly insect, which adheres so closely to the stem, or under side of the leaf, that the mixture cannot reach its vulnerable parts; therefore, in this case, the mixture must be applied with a brush that will dislodge the insect. If the mixture be put into a wooden bowl, or any other shallow vessel, small plants in pots, and the leaves and branches of larger ones, and of fruit trees, may be easily immersed in it by pressing them down with the hand. The above mixture will not destroy the black aphides of the cherry-tree, nor the green aphides of the plum-tree, by immersing the leaves and branches in it, there being an oiliness on these insects which prevents its adhering to them."

ACCIDENTS. Occasional injuries to live stock or to growing corn. The most serious accidents which happen to live stock will be noticed in the articles **WOUNDS, BRUISES, SPRAINS, and POISONS** [which see]; and the chief which happen to growing corn are such as arise from heavy rains, from fogs or mist, from frosts, from hail, from snow, from excessive heat, from blight, from calms, from variable weather, and from insects, birds, and vermin. Some of these will be fully examined, and others partially noticed, in their own alphabetical places; and any need be noticed in this place, only so far as to afford an entire view of the injuries to which crops are liable.

Heavy rains, when wheat is in flower, wash away its pollen, and prevent it fecundating and fructifying; they sometimes, on insufficiently drained land, keep the roots of plants in so wet a

state as to occasion abortion in the ear; and they frequently throw large portions of a crop prostrate, or, in farmers' phrase, lay or lodge it,—to the risk of its not coming to maturity, or of its being harvested with difficulty.—Fogs, when so prevalent as to make a succession of moist and gloomy weather, especially during the period when corn is at the height of its vegetation, sometimes subject whole crops, particularly those of wheat, to sickliness and disease.—Frost, if the ground is in fine tilth and full of moisture, frequently elevates the surface of the soil, together with the young wheat plant, and separates the latter from its seminal roots; and when a thaw comes, the plant, in consequence of its supply of nourishment having been cut off, turns black or dies. So long as wheat continues in a low grassy state, it usually recovers from any checks which frost gives it; but when it is making its principal shoot previously to its producing its blossom, it grows for a little time with excessive rapidity, is very sensitive to changes in the atmosphere, and receives certain and severe damage from frost or from even a sudden fall of temperature. The injury ascribed to frost, however,—except when roots and tissues are ruptured by mechanical action of the soil,—are really occasioned by the play of subsequent heat or of the sun's rays upon the plant; and, in the case of early pease, of garden potatoes, and of half-hardy flowering plants, it may generally be prevented by giving a watering a little before sun-rise. "The damage done to wheat by frost," remarks Sir John Sinclair, "depends much on the temperature and brightness of the succeeding day. Should it be cold and gloomy, the injury is less; and if rain should fall, the plants will escape unhurt. But if the morning be warm and bright, the leaves of the plant often become black, and never revive, the effect corresponding to the degree of the returning stimulus."

Hail, occasionally in Great Britain but frequently on the European continent, beats down, shakes, prostrates, and otherwise damages corn; and, in some instances, when the crops were in full ear and nearly ripe, it has desolated whole districts of France, and occasioned scarcity and dearth of food.—Excessive heat or prolonged drought deprives corn plants of their necessary degree of moisture, renders them sickly and feeble, forces them into premature ripeness, and occasions them to be very light in straw and comparatively unproductive in grain.—Atmospheric influences of various kinds, particularly those of electricity and of unusual winds, are supposed to occasion some of the diseases in corn-crops loosely designated blights: see the article **BLIGHT**—A prolonged calm or a high degree of shelter deprives corn-plants of the requisite degree of ventilation and exercise from the wind, arrests or dwarfs their growth, and sometimes forces them into decay and death. The circulation, the cleansing power, and the gently shaking action of the

air, are chief means of supporting healthy plants, and bringing them to perfection; and when these are prevented, either by a prolonged calm, by the great height of hedges, or by overshadowing woods, the plants unduly retain the moisture of dews and rains, want the requisite degree of motion or exercise for the maintenance of their vigour, and, in consequence, become weak, dwarfish, or diseased.—Much variableness of weather, particularly in great and frequent transitions of temperature, damages the tender organs of plants by alternate expansion from heat and contraction from cold, and sometimes engenders diseases which completely perplex the farmer as to both their nature and their cause.—Various worms and minute flies often inflict enormous damage; but they will be noticed under the words GRUB, WHEAT-FLY, and numerous others indicated in the article INSECTS.—Sparrows, pigeons, crows, game, rats, mice, and other birds and vermin, often prey largely upon crops when they are ripening, or while they are winnowing in the field, and after they are secured in the stack-yard and the granary; but these also will be noticed in various articles, under their appropriate headings.—The hazards to which crops are liable, and the accidental losses which a farmer may sustain, are thus more numerous and far more serious than a superficial observer would suppose; yet many or even most of them may be much alleviated or wholly prevented or repaired by foresight, skill, and the operations and appliances of enlightened husbandry. The proportion of damage ultimately sustained from accidents by a thoroughly good farmer on a properly conditioned farm of the nineteenth century, is little more than a trifle in comparison to the average amount of damage sustained by almost any kind of farmer of the middle ages of Europe.

ACCLIMATATION or ACCLIMATION OF ANIMALS. The enabling of the domestic animals to sustain, without serious injury, a great change of climate. In removing oxen, for example, from the climate of Kentucky or of Tennessee to that of Louisiana in America, farmers and cattle-dealers have long known that the most serious risk is incurred, and have been in the practice of earnestly using means—many of them absurd and capricious—for averting or lessening the risk. The average pulse of the ox in a cold climate is about 50 in a minute, while its average in the climate of Louisiana is from 68 to 75; so that, when any individual of the species is removed from its native country to a place of considerably higher temperature, the action of its heart is powerfully stimulated, and its whole constitution undergoes a violent change. The injury done to any animal by a sudden, great, and permanent increase of the circulation must necessarily be serious; but, in consequence of its arteries being smaller in proportion than those of the ox and of some other animals, it is particularly serious to the ox. The proper treatment for averting

danger, or duly acclimating the creature, is a gradual, steady, and considerable reduction of its animal energy. Dr. James Smith of Louisiana, in a paper on this subject in the Quart. Journ. of Agriculture, says:—"The quantity of food which the system will in ordinary circumstances require must be diminished, and all the common exciting causes of increased arterial action, such as the heat of the sun, quick motion of any kind, be avoided. Besides these, medicines which have a tendency to diminish the heart's action, must not only on the first attack of fever be resorted to, but should, we think, even in a state of health (though no advocate for such treatment generally), from time to time be administered. Bleeding, though the most valuable of all remedies on the attack, must not previously be resorted to, from a tendency which it has to produce in the system increased action, for the purpose of reproducing the matter taken away. Proper doses of the *Digitalis purpurea* (foxglove) may also be resorted to, and indeed all remedies which have a tendency to diminish the heart's action. Shade, a plentiful supply of water, for the animal to stand in during the heat of the day, I conceive to be of all things the most essential."

Besides special cases like those now alluded to, the general question of the influence of climate upon the reproduction of animals imported from foreign countries merits a high degree of attention from the agriculturist. In the same manner that vegetables, when transplanted from a burning to a cold climate, multiply but seldom and with difficulty in the ordinary way, we remark that animals imported from a very warm to a very cold country often become unfruitful. It has frequently been noticed, that Arabian mares, when brought to Britain under different circumstances, either become unfruitful, or yield feeble and unprofitable results. The stallions of many races are sometimes in the same situation, even when transported to a much shorter distance. M. Yvart remarks, that the asses of Tuscany and Spain are not always productive in France, or in countries lying farther to the northward; and it is well known, that in all the northern countries of Europe, animals of this species yield products greatly inferior in appearance to those of the South. The other domestic animals present us with results which may be regarded as equivalent to the preceding, after making due allowances for the differences between the climate of their residence and that of their original country. Thus, we may remark that the sheep and bull seem rather to deteriorate on removing from the north to the south of Europe; now these animals appear to have belonged originally to countries where a cold and moist atmosphere was more prevalent than one of an opposite character. On the contrary, as we have just observed, a different result is obtained in respect to the horse and ass, which were originally natives of the South.

M. Roulin, in a paper read before the French academy of Sciences in 1828, on the changes which the domestic animals of Europe undergo when transported to the equatorial regions of the New world, states that the mammiferous animals brought from the Old to the New continent, are pigs, sheep, goats, asses, horses, cows, and dogs, all of which are become more numerous than the indigenous animals of the new countries. It appears that the hog, in the warm valleys of South America, wandering in the woods, and subsisting upon wild fruits, becomes very ferocious, and assumes almost the character of the wild boar. The principal treatment to insure fecundity in these animals, was to pasture them in situations where the food possessed saline properties. In places where the quantity of salt, either in the water or plants, was small, they were found to deteriorate in quality, and to diminish in number. In these climates, the cow undergoes a material change. It no longer furnishes the constant supply of milk which we obtain from it by artificial means in Europe; and, in order to obtain that fluid at all, it is necessary that the calf should be continually with its mother. The milk obtained for domestic use, is only that which accumulates during the night when the calf is in a quiescent state; when the calf ceases to suck, the milk immediately dries up. The bulls and cows introduced from Europe into South America soon become wild; and, at the present time, it is only by repeated battues that they are kept in subjection. The ass undergoes, in the provinces which M. Roulin has visited, less change than any other animal. He never becomes wild but in situations where the labour is excessive. The sheep introduced into America were not the merinos, but the two species called *tana basta* and *burda*. In temperate climates, they have multiplied abundantly, without showing any tendency to submit to the domination of man. In the burning climate of the plains, they do not propagate freely; and a curious phenomenon is there witnessed. The wool of the lambs grows at first, as in more temperate climates, but rather slowly. When in a fit state for shearing, there is nothing remarkable about its quality; and, when removed, it grows again as in temperate climates: but if the proper time for shearing is allowed to go by, the wool becomes thick, falls off in patches, and leaves underneath, not a new growth of wool or a barren place, as if from disease, but a short shining and close hair, exactly like the hair of the goat, in the same climate: and, where this hair once appears, there is never any return of wool. The goat, notwithstanding its form, which appears adapted to mountainous situations, thrives much better in the low valleys of South America than on the high points of the Cordilleras. It undergoes a lactiferous change similar to that of the cow. The conclusions drawn from the report are, 1st, That every animal, like man, requires time to accustom itself to climate; and,

2d, that domestic animals, when left to themselves, have a great tendency towards the organization of those of the same species in a wild state; and that a very short time only is necessary to produce that transformation.

That degeneration of individuals, so frequently remarked in animals and plants, results inevitably from their being imperfectly acclimated; and many of the diseases with which they are afflicted proceed from a similar cause. In the southern countries of Europe, the insensible exhalations which transpire from the surface of the skin are usually considerable, while the contrary takes place in its more northern regions. Hence, in importing animals from the South to the North, due care should be taken to overcome their constitutional habit in a gradual manner. There is a constant determination of all useless or hurtful matters towards the skin in warm climates; while, in cold countries, transpiration is counteracted, arrested, or suspended, and always modified in a greater or less degree. Hence, unless their change of situation is cautiously effected, animals become predisposed to several cutaneous disorders, to obstructions, enlargement of the liver, and other maladies of this nature. Again, when animals are suddenly transported from the North to the South, and without the necessary precautions, the consequences are not less dangerous than those already enumerated; as the excretory functions of the skin are less energetic in cold than in warm countries, the internal functions possess a greater relative energy; and, on removing them to the South, their constitutional habit becomes modified. The insensible transpiration of the skin necessarily becomes greater, and the active forces of the system tend towards the surface,—a change which may occasion many dangerous maladies, such as putrid fevers. The only effectual way of counteracting these serious inconveniences, is by adopting a system proper to all the circumstances of the locality, according to the principles laid down in our best treatises.

Climate exercises an important influence over many of those characteristics which commonly serve to distinguish one species from another; and it is highly probable, that many animals, which are commonly considered by naturalists as belonging to allied species, may in reality be nothing more than permanent races, descended from the same original stock, and preserved distinct solely by the influence of climate. The usual characters of animals, when long exposed to dry and warm climates, may be stated in general terms to be the following:—Their skin is thin, supple, and oily; their hair scanty and fine; their limbs long; the tendinous parts distinct; their horns hard, dry, and brittle; the hoof contracted; the feet narrow and sound; the muscles dry and but slightly fat; and their temperament rather sanguineous than lymphatic. The circulation of the blood becomes accelerated; they possess much ardour, energy, and courage; while the several

parts of their bodies seldom acquire very voluminous proportions. On the contrary, animals exposed to a cold and moist climate, along with more strongly marked proportions, have their skin thicker, harder, and drier; their hair longer, coarser, and more bushy; their extremities shorter, with the tendons less strongly pronounced; the horns softer and more spongy; the feet larger, broader, more flattened, and less compact; the muscles stronger, closer, and well supplied with fat. Their temperament is rather lymphatic than sanguineous; their circulation is slower; they possess less physical and mental energy, and may almost be said to consist wholly of matter, as they are visibly deficient in ardour, energy, and courage. The animals of temperate climates occupy in all respects a mean between these two extremes.

Animals have, as well as vegetables, their natural habitations and stations, to which they should be approximated as much as possible in the state of domestication; and it is always dangerous to separate them from these localities without the greatest caution. Nature often places insurmountable obstacles to their migrations, by depriving them, as we have already seen, of the power of reproducing anywhere except in their native countries. The study of habitations and stations is therefore of the highest importance in the management of the domestic animals. By the term *habitation*, we commonly understand the climate which each animal prefers, because it is best adapted to its organization; and by *station*, that particular place which each of them chooses in the same country and under the same climate, from its finding more resources in that locality for living and satisfying all the conditions of its organization. Thus, the habitation of the rein-deer appears to be irrevocably fixed to the frozen countries adjoining the North pole, where this animal has long been domesticated, and yields the most important services. After the many unsuccessful trials which have been made, it may be considered as almost impossible to render it acclimated in the temperate plains of Europe. Perhaps it might succeed, with the proper precautions, on the summits of our coldest mountains. Again, the natural station of the rabbit is on a sandy and dry soil; that of the sheep and goat in dry and elevated regions; the buffalo and bull delight in low and moist situations. These animals cannot be separated entirely and suddenly from their natural stations, without exposing them to inconveniences more or less serious. In all attempts at acclimating foreign animals it is, therefore, as important to study their natural station as their habitation.

Wherever the same temperature prevails, and in whatever latitude, it is generally possible to find some spots where animals may be imported with success, where they will multiply like plants in analogous situations. It appears also, that

those animals which Nature has placed in the temperate climates, may extend themselves insensibly towards the opposite extremes of heat and cold; for, as Pallas has judiciously observed, all our domestic animals of the North and South are found wild and apparently native, in the temperate regions of Central Asia.

It has long been remarked that those animals, as well as plants, which have their natural station in dry and elevated countries, are analogous to the living productions of cold countries; and that those species which delight most in low and moist grounds approach more nearly in general character to the productions of the South. This serves to indicate that it is commonly more advantageous to attempt the acclimation of animals from warm countries in low localities, whilst those of the North are most easily naturalized in dry and elevated regions, and it is always useful in practice to study these analogies by attending to the natural disposition, whether low or elevated, which a cold or warm country is capable of affording. It seems probable, also, that individuals will be more easily acclimated in places which form the natural stations of congenerous species, than of those greatly removed from them, for the same dispositions and qualities are usually found to exist in animals belonging to the different species of the same genus. The chances of a successful acclimation are further increased by the adoption of a similar, or at least a kind of food analogous to that which they would have received in their native country; and, in some instances, this is indispensable to their existence. Thus, we often see birds, directed by the migratory instinct, resorting to localities where they can find that kind of food which is necessary to their existence, and of which they have been deprived by the severity of the climate.

It follows from the above observations, that whenever animals are imported from a country which is very hot or very cold, very dry or very moist, to one which is less so, and that it becomes desirable to maintain them in a state of health, so that they may continue their species by generation, and in general maintain the healthy exercise of all their functions, it becomes necessary to observe the following precautions:—1st, To approximate them by a convenient and suitable position to their original and natural situation; and, 2dly, To avoid all sudden transitions with the greatest caution, so as to acclimate them gradually. The climate, as we have already remarked, exercises a most direct and powerful influence upon the physical and intelligent powers of all animals as well as upon their offspring; and hence we may readily anticipate alterations more or less sensible and permanent, on transporting them suddenly, and without the suitable precautions, to remote distances, or perhaps to situations of an opposite kind to those whence they were abstracted. The effects become more apparent when their transportation is effected from

the warm to the cold climate. It may be added, that it is frequently more advantageous to remove animals which are still young, because, from their being more pliant at this age, they habituate themselves readily to the change, and in the end endure the unfavourable circumstances to which they are exposed. A very sudden and powerful change is, however, better endured by the adult animal, whose frame being more matured, is better capable of resisting the shock.

With the domestic animals, we commonly find that temperate climates, where they are exposed but little to sudden changes of the atmosphere, are in general those which agree best with their natures, and where they are least subject to deformity and disease. In these situations they also become more mild and tractable, as their natures assume the general aspect of the climate, while they seem to acquire a certain degree of rudeness and asperity from the contagious influence of an unhospitable region. See article CLIMATE.

ACCLIMATATION OF PLANTS. The accustoming of plants to thrive in a climate which differs widely from their natural one, and which, previous to their being accustomed to it, would damage their organism or derange their functions. Some writers distinguish between acclimation and naturalization; and, after assigning to the latter an extensive scope of influence, and even identifying it with many of the achievements of cultivation, they conclude that acclimation either operates within a very limited range or does not at all exist. But when naturalization means the mere removal of a plant to a country of very similar climate and condition to that in which it is indigenous, it exhibits no phenomena, possesses no character, and cannot claim consideration as either a principle or an art in cultivation; and when, on the other hand, it means such treatment of exotic plants, whether by dressing, by forcing, by repressing, by hybridizing, or by any other appliance, as fits them to sustain without injury a lowness of temperature or a severity of weather which would formerly have destroyed them, it achieves exactly the same results as acclimation, and is perfectly identical with that process in everything but the name. The blunder of any gardener in Great Britain who receives a new plant from a hot country, nurses it for a time in the hothouse, transfers it gradually and cautiously to the open ground, and says he has acclimated it, while it really possesses so much constitutional hardiness that he might at once and with all safety have placed it in the open border,—or who receives a new plant from a temperate country, gives it the same treatment as the great majority of his hardy plants, finds it languishing under his eye, restores its energy and establishes its health by some unusual method of culture, and says he has acclimated it, while it really grew in such peculiar circumstances in its native country as ought to have suggested to him

from the first what sort of treatment was requisite for its prosperity,—these blunders, no matter how often repeated, can neither abolish nor mystify any one of the thousand well-proved facts respecting the controlling power which culture exerts upon the habits of plants. Because, a century or two ago, one clown tried to eat tea leaves with butter, and pronounced tea an abomination, are we to be told that tea is not an agreeable beverage? or because another clown tried to eat potato-plums, and kicked the whole plant out of his ground as a nuisance, are we to be told that the potato is an odious weed and no article of food? Certainly not; and yet the blunders of the clowns are just as good arguments against the right use of tea and potatoes, as the blunders of erring gardeners against the principles and practices of acclimation.

Cultivation brings old and well known plants to perfection; it introduces new species from foreign countries to our gardens, from hothouses to the open border, and from gardens to the fields; it multiplies varieties, develops hidden properties, and expands a small genus or a single species into a great and diversified family; it enlarges valuable organs, diminishes annoying organs, and evokes sweetness from acidity, and beauty from deformity; it works corollæ into leaves, leaves into corollæ, branches into roots, and roots into branches; it draws the most luscious fruits from the juices of acrid stems, and evolves the most fragrant flowers from the sap of naturally odourless plants; it accelerates fructification in a biennial so as to convert it permanently into an annual, and retards fructification in an annual so as to convert it permanently into a biennial; it has transmuted a trivial annual grass which matured its seeds in about six months, into the richest of the farinaceous grains, which slowly and sturdily elaborates its progress to maturity during the long period of twelve or thirteen months; it has worked the sour and worthless crab into the numberless and luscious existing varieties of the apple; it has lifted the naturally poisonous peach from its original habitat in Media, and worked it into one of the most wholesome and delicious of fruits upon the plains of Egypt and Ispahan; it has transmuted one paltry and miserable weed—the *Brassica oleracea*—into all the existing varieties of white cabbages, red cabbages, borecoles, savoy, Brussels' sprouts, broccolis, and cauliflowers; it has naturalized, in our fields, in our orchards, and in our open gardens, many hundreds of the most valuable plants of more than one-half of all the countries of the world; and, wonderful, innumerable, and of incalculable worth as are its undoubted achievements, it has wholly accomplished not a few, and partially accomplished a very large proportion, by some one or more of the processes of acclimation.

The celebrated botanist, De Candolle, indeed, seems fully to doubt whether any degree of ac-

climatisation has ever taken place, or can be proved possible ; and he even defines naturalization to be little, if any thing, more than the transporting of a plant into a different country from that in which it originally grew. But Keith justly asks, in reference to such naturalization, whether a mere journey overland or voyage upon the ocean can make a plant agree with new conditions of existence ! and, in reference to the supposed doubtfulness of acclimatisation,—“ with the fact before our eyes, that plants from warmer climates, as *Aucuba Japonica*, and *Peonia moutan*, do ultimately become accustomed to colder climates, by occupying first the hothouse, and then the greenhouse, preparatory to their being exposed to the open air, how can we refuse to admit the possibility of acclimatisation ?” Nor might he have pointed only to the two remarkable and well-known instances of unquestionable acclimatisation which he specifies, but, more or less, to the greater portion of the finest ornaments of our gardens, the greater part of the most delicious produce of our orchards, and even a considerable portion of the most common and valuable productions of our fields. No enlightened farmer is speculative enough to agree with De Candolle, or stupid enough to regard the topic of acclimatisation as ideal or uninteresting ; for every farmer of moderate information knows that a large proportion of crops now grown on cold or upland soils owe their ripening powers to acquired or acclimatated earliness in particular varieties of grain,—that a series or succession of maturity among varieties of potatoes, turnips, and other green crops available for the purposes of alternate husbandry or the soiling of cattle, has, in a great degree, resulted from acclimatisation,—that, in a word, a very large proportion of the whole produce of a farm has, in modern times, been so modified by the acclimatisation of its plants, as to be far better adapted than before to the exigencies and the critical conditions of our seasons. Yet all such facts known to farmers are as nothing compared to the crowds of corresponding facts known to gardeners.

The Siberian crab, in its native country, experienced a sudden and invariable transition from a rigid winter to a warm and sunny winter ; and, in consequence, it burst, year by year, suddenly and gorgeously into the full blush of its beauty, and continued to display its energy till the end of the summer. When first introduced to Britain, it knew nothing of our alternations of frost and thaw, and still less of our period of sharp spring frosts which may be designated our second winter ; and it burst into foliage at the earliest retreat of our first frosts, exhibited in February all the beauties of May, sustained violent shocks from the frosts of spring, and drooped and died of exhaustion just at the moment when other trees were awaking from sleep and shaking into action their yearly energies. But now this fine ornament of our shrubberies has acquired a know-

ledge of our climate, and accommodated its habits to our seasons ; it does not so hastily as before put confidence in our treacherous spring, but exfoliates itself with due slowness and caution, and so escapes destruction, and flourishes as steadily as in its native country.—The laurel, when first introduced to England about two centuries ago, required to be protected from frost by so warm a covering as a blanket ; and yet is now a hardy and an universally diffused evergreen. Plants of laurels raised from cuttings grown in this country, are well known to be hardier and healthier than plants raised from foreign seed.—The *Aucuba Japonica*, so like the laurel in some respects, and so often to be seen growing along with it in the open shrubbery, was, as already hinted, originally a hothouse plant in Great Britain,—not in consequence of a blunder, but, if not from downright necessity, at least from ordinary prudence.

“ In the year 1791,” says Sir Joseph Banks, in the Transactions of the London Horticultural Society, “ some of the seeds of the *Zizania aquatica* (Canadian rice) were procured from Canada, and sown in a pond at Spring-Grove, near Hounslow ; they grew and produced strong plants which ripened their seeds. These seeds vegetated in the succeeding spring ; but the plants they produced were weak, slender, not half so tall as those of the first generation, and grew in the shallowest water only ; the seeds of these plants produced others the next year, sensibly stronger than their parents of the second year. In this manner the plants proceeded, springing up every year from the seeds of the preceding one, every year becoming visibly stronger and larger, and rising from deeper parts of the pond, till the last year, 1804, when several of the plants were six feet in height, and the whole pond was in every part covered with them as thick as wheat grows on a well-managed soil. Here we have an experiment which proves that an annual plant, scarce able to endure the ungenial summer of England, has become, in fourteen generations, as strong and as vigorous as our indigenous plants, and as perfect, in all its parts, as in its native climate.” But the *zizania*—which abounds in all the shallow streams of North America, feeds immense flocks of wild swans and other water-fowl—contributes largely to the support of the wandering tribes of Indians, and seems destined, in the opinion of Pinkerton, to become the bread-corn of the North,—this grain has now become acclimatated, not only in Middlesex, but in Ross-shire, producing bland farinaceous seeds, which afford a very good meal. The conclusion drawn by Sir Joseph Banks and by Dr. MacCulloch from these facts is, that while those plants not belonging to our own climate, which have been propagated by cuttings, retained the tenderness or delicacy of the original parents, when produced from seeds they became comparatively hardy, and may, in a certain number of successive generations, become perhaps as hardy as any of our native vegetables.

The potato was introduced to Europe from the mountainous parts of South America, about the middle of the 16th century ; and it has not now been grown in the gardens of Great Britain above 187 years, nor, to any considerable extent, in our fields above 92 years. During the whole period of its cultivation it has been treated with the greatest care ; yet it was, for a long time, so decidedly exotic as to refuse to mature its seeds ; and even yet, in some unfavourable situations, particularly in the Highlands, it sometimes suffers general and utter destruction by one night's early frost. Acclimatation has already done much for the potato by working out many earlier varieties, and by training the later sorts to mature their seeds, and to resist the action of moderate frosts ; but it will probably do yet much more for it by such frequent, careful, and scientific sowings, as will not only yield valuable new varieties, but produce comparatively hardy plants, capable of offering a sturdy resistance to early winter.—The dahlia was introduced from Mexico to Spain in 1787, but reached Paris only in 1802, and did not come into general cultivation till several years later ; and yet it has already passed from habits of excessive tenderness, and of very late flowering, to those of semi-hardiness, and of a comparative degree of earliness. It was at first raised only in the hothouse ; it was with difficulty transferred to the open border ; it not very long ago refused to bloom in the open air earlier than about the middle of October ; and now it is very nearly as hardy as the potato,—it is cultivated and preserved by closely similar methods to the potato,—it sometimes, when treated almost exactly as the potato, blooms freely in the open air in Scotland from about the 8th of September to about the 24th of November,—and it has altogether undergone so great acclimatation as already to seem quite capable of being raised in the fields for food.—The aracacha, one of the most useful vegetables of South America, is in some respects a more interesting object of both the physiologist's and the farmer's attention than the dahlia, or even the potato ; and, though at present conflicting with the difficulties of our climate, it has, for some time, been justly obtaining a large portion of observation and care. See ARACACHA.

The hemp of New Zealand, *Phormium tenax*,—so much more productive of fibre than our own hemp or flax, and capable of being manufactured into the strongest cordage used in the navy,—has succeeded, in a few specimen instances, in the gardens of Scotland, and grows healthily in the fields throughout the east and the south of Ireland, and may possibly become so acclimatated as to yield a suitable and remunerating crop on the farms of Great Britain.—The Zea mays or Indian corn, which affords an excellent provender for all live stock, and in times of scarcity has been highly prized by the human population, makes itself perfectly at home on the poor sands of Norfolk and

Suffolk, or on any hot burning lands in the south of England, and may probably accommodate itself to many of the lighter kinds of soils throughout the north of England and the south of Scotland.—Tobacco has overcome all reluctance to flourish and seed in our gardens ; and, if permitted by law to be generally grown, might, for a short time, be cultivated with vast profit by the farmer.—The *Tetragonia expansa*, or New Zealand spinach, was introduced in 1772, and treated for some time as a greenhouse plant, but now it is as hardy as the nasturtium, keeps its ground from year to year wherever it has been sown, and, in some spots in the south of England, has even become quite a weed.

The splendid annual *Coreopsis tinctoria*, a native of the West Indies, is now quite hardy in most of our gardens, and perpetuates itself by seeds which resist the winter on the spot, and germinate vigorously in spring.—The universal favourite mignonette, *Roseda odorata*, was first brought from Africa in 1752, and was for some time cultivated in the hothouse ; but it is now perfectly acclimatated, and matures its seeds in the open ground.—Our superb greenhouse plant, *Canna Indica*, or Indian shot, has become so completely familiar with the climate of Guernsey, as to scatter there its seeds every year, and even become a troublesome weed in the gardens. But the beautiful flowering plants which not very long ago were cultivated only in our conservatories, our greenhouses, and our hothouses, and which now withstand all our ordinary frosts, and thrive and bloom in the open air, are too many to bear enumeration. "Thus," remarks Dr. MacCulloch, "we see everywhere flourishing in the borders the most luxuriant plants of heliotrope, fuschia, *Verbena triphylla*, geraniums, and numerous others, replacing the wretched starved specimens formerly nursed with the greatest anxiety in the greenhouses." Numbers of these plants, indeed, had their constitutional habits been properly known, might probably have, from the moment of their introduction, been committed to the open ground ; but the greater number seem, beyond all reasonable doubt, to have undergone a real acclimatation,—while a few have been acclimatated to the wonderful extent of a revolution in their habits or total change in their constitution. "It remains, however, to be proved much more clearly than yet has been done," says Dr. MacCulloch, "what it is precisely by which the hardiness of plants is regulated, or how it is influenced. It is easy to make use of general terms, but they will not satisfy a philosophical mind. The effect of frost can unquestionably be understood in a general way ; yet the tender greenhouse plants of England, which are hardy in Guernsey, are not killed by the frosts, in which that island is not wanting, nor by the cold easterly winds, which prevail there with considerable duration and severity. They have always survived those attacks ; and sometimes, with the

usual shelter from long east winds, have passed through even those very severe winters, so well remembered, in which this island proportionally participated." * * * "I believe," the Doctor adds, "that in a great many matters appertaining to vegetation, whether in horticulture or agriculture, the question of light is often of much more importance than that of heat, however much it has been overlooked by agricultural as well as philosophical writers. It is of most material importance as to the perfection of flowers, whether in vigour, colour, or odour; and not less so, as is very well known, as to the ripening of fruits. Nor does it appear to me less so as to ordinary agriculture, whether as it relates to the perfection of certain herbaceous plants, or the ripening of grain. I think this is peculiarly visible in certain parts of Scotland, where the most serious differences in this respect occur; where no other circumstance of difference than that of the annual quantity of light can be discovered, and when indeed the condition as to temperature, and soil both, is highly in favour of those climates where the produce is worst. This is remarkably true in comparing the eastern and western sides of Scotland generally, and in noting the singular limitation of the region of wheat thus produced; and, unless I mistake, a difference in the vigour, and especially in the vigour of flowering, in clover, not to be accounted for by differences in the soil, method of cultivation, or quantity of manure. And while the power of producing wheat, or what, for the present purpose, is analogous in principle, the early ripening, as well as the superior quality of barley, diminishes in proceeding westward on a parallel of latitude, till we arrive at the cloudy region, it reappears on passing this again to the westward; insomuch, indeed, that much more northern latitudes, if the lands are insular and flat, are superior in these respects to the southern ones, while there are no differences as to soil, cultivation, or aught else, capable of explaining the facts."

Plants, in general, bear to be removed from cold to heat better than from heat to cold; and, therefore, a greater proportion of the plants of this country thrive in the south of Europe, than of the plants of the south of Europe will thrive in this country. Yet the reverse of the general rule, in both of its applications, may frequently be observed. The removal of some of our plants to considerably warmer climates than our own, is often a task of much inconvenience and difficulty; and the successful removal of a few others is an utter impossibility. Wheat and barley, for example, will not grow within the tropics; and several of both our shrubby and our succulent plants would soon wither to extinction in any region of much heat and drought. Many plants of hot countries, on the other hand, readily accommodate themselves to our climate, either by means of the protection they obtain during winter from snow, or with the help of the warmth and shelter

afforded by our shrubberies and plantations. "Every one, on entering a wood in winter, must have been struck with the difference of the temperature from that of the open field, as well as seeing there several plants, such as the cowslip, violet, and snowdrop in full flower; while, in the neighbouring gardens, their leaves have scarce made their appearance. It is well known that many rare plants, which had disappeared with the cutting down of a wood, have reappeared when it has again grown up. 'One reason why the American plants grow so luxuriously at Fonthill Abbey,' says a writer in the *Gardener's Magazine*, 'is, that they were introduced among native underwood, interspersed among bushes of hazel, dogwood, &c., and sheltered by firs, oaks, and other timber trees.' A shrubbery is therefore to be considered as the best place for acclimating exotics, whether trees or herbs, and more especially if the soil be dry, and the shrubs chiefly deciduous; for it should not be forgotten that many believe that a coppicewood of evergreens is always colder than one of deciduous bushes, owing to the leaves presenting a greater surface for evaporation. Groves of evergreen trees, on the other hand, especially of the pine and fir tribe, present a warmer climate beneath them than groves of deciduous trees; because the former, from the closer texture of their exterior surface, reflect back more completely the heat radiated from the ground below. The more any plant is shaded in winter, the less danger it will be in of suffering from frost. For, when a plant or water is so situated as to be overtopped by trees, the radiation of caloric is in a great measure checked; and thus, in such situations, we may often observe water unfrozen, and plants unhurt by the cold, and many retaining their leaves, when others of the same species, at a short distance, but unshaded, lose their leaves, and suffer considerably." —[*Paper of J. S. Bushnan, Esq., in Quar. Journal of Agriculture.*] Yet constant shade in summer might, in many instances, far more than counterwork all the advantages of constant shelter in winter; and the want of a free soil and a suitable ventilation during winter itself, may, in some cases, be ill compensated by mere protection from some degrees of cold. The shelter of woods and shrubberies as a means of acclimation, therefore, must be understood to have decidedly restricted limits, and ought to be employed only in the case of plants which naturally grow on poor soils, and receive little damage from the dropping and the shade of trees.

Mr. Bushnan, immediately after the passage which we have quoted, says, "Mr. John Strut, the gardener at Beil, who has succeeded in acclimating numerous plants, states, in the *Transactions of the London Horticultural Society*, that he has found poor, dry, and shallow soils and declivities to be best adapted for preserving plants through the winter season. The quicker the superabundant fluid passes away from the roots the

better. From every observation, it appears, that those plants which have the least sap in winter, or whose sap is of a resinous or oily nature, suffer least from cold. It would be foreign to our purpose to enter into a discussion of the cause of this, or of the theories that have been built upon it; suffice it to say, that it has been supposed that the principal cause of the destruction of tender plants in winter, is owing to the vessels being burst by the freezing of the sap. In choosing plants, therefore, for our experiments, we should attend to their organization: annuals bear exposure better than perennials; and those abounding in sap, having a spongy, porous wood and much pith, succeed with difficulty. It seems advantageous that those plants to be tried should be deprived of moisture as much as possible. Mr. Strutt found that, when planted above drains, several reputed greenhouse species have flourished most luxuriantly. Plants do not suffer from frost in dry situations, nearly so much as they do in moist, or when an excess of rain is followed by a severe frost. The reason is evident,—in moist situations, part only of the moisture is evaporated during the day, the rest remaining to be converted into ice by the cold of the ensuing night. This icy covering increases the cold, till the vital principle, and resistance given by the formation of the bark to the entrance of the cold, are overcome; the sap is frozen, and the vessels burst by the expansive force of freezing."

Any farmer of ordinary intelligence and skill may easily turn the doctrines of acclimation to considerable practical account. He will as nearly as possible calculate the comparative warmth and coldness of the different soils and situations upon his farm; and if these should exhibit very sensible differences and gradations, he will not in every instance subject the whole to indiscriminate cropping and rotation, but will occasionally, or as often as comports with higher considerations, assign the warmest soils and situations to the most tender varieties of plant, and the soils and situations of quickest power to such varieties as are tardiest in ripening. He will regard the thorough draining of light land as equal to a removal some lines nearer the equator, and as probably capacitating his field to produce a species or a variety seldom hitherto grown so far to the north. He may occasionally harden a new and favourite but somewhat tender variety of a plant by growing it, for a series of years, under conditions at first fostering, and afterwards less and less genial. He may possibly introduce a half tender garden-plant to the fields, or a plant of a warmer zone to a colder one, by cultivating his earliest specimens with care, and afterwards combining from year to year a lowering of the conditions of culture with a strict selection of seeds from only the healthiest and strongest plants. He may work out rapidly maturing varieties of grain, such as may be suitable for the most backward

soils and situations, by sowing an existing early variety, selecting his seed-corn for next season only from a few plants of it which ripen before the great bulk of the crop, and repeating this process for a brief series of years. He may, in one word, conduct one set of acclimating experiments on a small plot expressly allotted to them, and another set co-ordinately with his routine business of culture and cropping; and may, as the result, effect upon several of the most useful species or varieties such modifications as will both increase the profits of his farm and render him a benefactor to his profession and to society at large. A few experiments, so far as they do not waste his time or substitute any speculative practice for sound and well-tested husbandry, can at all events do no harm, and will at least produce the incidental good of increasing his acquaintance with the vitality and the functions of plants.

A gardener, of course, commands a far wider scope for acclimating than any mere farmer. Plants which he wishes to acclimate, in the broad sense of that word, should be placed in the open air at the beginning of summer, turned out of their pots into poor and very dry soil, and sheltered from the east and north winds; they ought to be removed from the hothouse to the greenhouse, from the greenhouse to the open frame, and from the open frame to the open border,—covered up during the whole of the first winter, and covered wholly, partially, or not at all during the second, according to the comparative mildness or severity of the weather. Plants in a warm climate perspire more than in a cold one, and therefore require a larger supply of moisture; so that while plants remain in a hothouse, they should be abundantly supplied with water,—when they become transplanted to the frame and to the border, they should have a drier soil.—*Quarterly Journal of Agriculture*.—*Loudon's Gardener's Magazine*.—*Transactions of the London Horticultural Society*.—*Keith's Botanical Lexicon*.—*Loudon's Encyclopædia of Agriculture*.—*Dr. Macculloch on the Naturalization of Plants, in the Quarterly Journal of Science*, vols. xxi. and xxvi.

ACCOUNTS. See FARM ACCOUNTS.

ACER—popularly MAPLE. A numerous and important genus of forest-trees and tall shrubs, represented by the well-known false-plane or sycamore. They are, for the most part, distinguished by either the beauty of their appearance or the very valuable nature of their timber; and they comprise about thirty species, and constitute the type of the botanical tribe or order called Acerinæ. See MAPLE. The tribe Acerinæ includes also the genus *Negundium* or box-alder, and is related to two orders which have for their types the lime-tree and the Barbadoes cherry,—*Tilia* and *Malpighia*; and its trees grow only in the northern hemisphere, chiefly within the temperate zone, and all, more or less, yield a saccharine sap, from which sugar can be made.

ACETABULUM. The herb penny-grass. Also

the cup or concavity of an animal's joint,—particularly that in the thigh of the horse. Both of them borrow the name from the vinegar saucer or original acetabulum of the ancients.

ACETATES. Salts formed by the union of the acetic acid with an earthy, alkaline, or metallic base. These salts are nearly all soluble in water. The acetates, especially those of alumina, iron, and lead, are chiefly employed in dyeing and colour-painting: some of them, as the acetate of ammonia, lead, potash, and tin, are used in medicine. The acetate of potash exists in the juice of many plants, and when they are incinerated passes into carbonate of potash.

ACETIC ACID. A very common vegetable acid,—largely employed in the arts, in domestic economy, and in medicine,—the same which, when in an impure and very diluted condition, is popularly called *vinegar*. Acetic acid exists, combinedly with potash, in sumach, ladies' bed-straw, the elder tree, and a great many other plants; it occurs in urine, animal sweat, and fresh milk; it is often generated in stomachs of weak tone, or such as are afflicted with dyspepsia; it is excreted by seeds during the process of their germination; it is copiously yielded by some animal substances, and by almost all vegetable substances, when subjected in close vessels to a red heat; and it is the result of the spontaneous fermentation of decomposing mixtures of either animal or vegetable matters with liquid. This acid, therefore, performs a very important part in the constant series of changes which go on in both the animal and the vegetable economies of a farm. "It is distinguished from oxalic acid," says Sir H. Davy, "by its peculiar odour; and from the other vegetable acids, by forming soluble salts with the alkalies and earths." An opinion was long entertained, that the vinous fermentation uniformly precedes the decompositions which evolve acetic acid. But remarkable and well known instances to the contrary, are the souring of dough, starch, and cabbages, each without any trace of the vinous fermentation,—the first making sour bread, the second making the sour waters of the starch manufacturers, and the third making the sour kroust of the domestic economy of the Germans. See article **ACETOUS FERMENTATION**. The varieties of diluted and impure acetic acid known to merchants and farmers are four,—wine-vinegar, malt-vinegar, sugar-vinegar, and wood-vinegar; but these will be more appropriately noticed under the words **PYROLIGNEOUS ACID** and **VINEGAR**: which see. The acetic acids should never be kept in painted vessels, since white lead—the basis of all pigments—is readily dissolved by these acids, and forms the poisonous compound known as sugar of lead. Neither should they be allowed to cool in copper vessels; nor should they ever be kept in common earthen vessels glazed with oxide of lead or litharge. Salt glazed stoneware, good English pottery, or glazed iron form the

safest materials for vessels employed in preserving, or boiling acetic acid, and its various preparations.—*Ure's Dictionary*.—*Thomson's Chemistry*.—*Johnston's Agricultural Chemistry*.—*Davy's Elements of Agricultural Chemistry*.

ACETOUS ACID. A liquid possessing a medium character, in the degree of its oxygenization, between pure acetic acid and the most common vinegar.

ACETOUS FERMENTATION. A change which many organic substances undergo spontaneously, under particular circumstances, becoming wholly or in part dilute acetic acid. It has been known from ancient times that the expressed juice of fruits, after becoming vinous by a species of fermentation, was subject to another change, by which it became sour to the taste, which conversion is now known to chemists as the acetous fermentation. Although there are many points which remain to be cleared up in some of the practical details of the acetous fermentation, yet we are enabled to lay down one principle as its cause in nearly all the processes of making vinegar, viz. that it depends on the absorption of oxygen from the atmosphere, the organic matter acting as a medium of conveying the oxygen from the air to the alcoholic fluid. Wine and beer only become acid when they contain organic substances capable of absorbing oxygen, for when the ferment by long-continued vinous fermentation is deposited, and the clear wine racked-off, it is little liable to become acetous; and beer subjected to very slow fermentation at a low temperature, likewise deposits its altered nitrogenous ferment in an insoluble state, and is not subject to the acetous change at common temperatures. Some vegetable substances are capable of undergoing the acetous fermentation without a perceptible previous formation of alcohol; and some indeed which are not known to be capable of the vinous fermentation. Thus sugar, by the addition of certain ferments, may pass directly into acetic acid without an intermediate absolute change. The conditions most favourable to acetous fermentation—or in other words, to the absorption of oxygen by alcohol—are as extended a surface as possible, the free yet not unlimited access of air, and a proper temperature. In the quick process, the temperature should be from 100° to 105°; but, as such a temperature, in the ordinary process, would create too great a loss by evaporation, in such cases it should be from 70° to 80°. When the fermentation has ceased, the vinegar should be racked-off, or filtered from the lees, which would tend to produce the putrefactive fermentation. What is called the mother-of-vinegar, a slippery, gelatinous, coherent kind of vegetation, has no effect whatever in promoting acetous fermentation, and being formed out of the acid, constantly tends to weaken it by its presence. Hence its formation should be avoided by excluding the access of the air. See article **VINEGAR**.

ACHANIA. A genus of evergreen shrubs of the mallow family. They comprise about fifteen species, and grow spontaneously in the West Indies and America; but are known in Great Britain only as hothouse plants.

ACHE. A very painful local affection in animals, unaccompanied by any visible symptom in or near its seat. Aches are very apt to arise in the limbs of horses from hard riding or from exposure to cold; but they can, at any time, be detected only by the general symptoms of pain.

ACHILLE'A. A numerous genus of herbaceous plants of the composite tribe, chiefly vile weeds, but partially of doubtful character between the noxious and the useful. Several of the species are well known to farmers under the name of YARROW [which see], and others are popularly known under the names of sneezewort and sweet maudlin. The total number of species is about seventy; and all are perennial herbs of the colder climates of the northern hemisphere. The *Achillea millefolium*, though long regarded as a nuisance on British pastures, has of late years found great and general favour with some agriculturists as an agreeable condiment to cattle, and with others as one of the most valuable ingredients in nutritious herbage.

ACHILLE'IS. A beautiful species of barley mentioned by Theophrastus and Gallen.

ACHNODONTON. A small genus of exotic grasses, of the agrostis tribe. They comprise only two species, and have their name from the toothed form of their paleæ. The bulbous species is a perennial, and a native of Spain; and the slender species is an annual, and a native of Mesopotamia.

ACHRAS—popularly **SAPOTA.** A genus of evergreen fruit-trees of South America. Its species are four in number; and two of them are popularly called the mammee and the naseberry trees. The bark of some of the species has the same astringent and medicinal properties as the well-known Peruvian bark.

ACICULA. A weed whose organs of fructification bear some resemblance to needles; either the wild chervil, *chaerophyllum*,—or the shepherd's needle, *scandix*.

ACIDIFIABLE. Capable of being converted into an acid: such as sulphur and carbon, which by combination with oxygen may be converted into respectively sulphuric and carbonic acid.

ACIDS. The most important class of compound substances known to vegetable physiology, to scientific agriculture, or to general chemistry. The name acid, as originally and for a long time used, meant strictly a sour substance; but, as chemical discoveries have expanded and multiplied, it has come to be applied to several liquid, solid, or gaseous substances quite destitute of sourness, and to some others whose sourness is barely perceptible. The characteristic property of an acid, as now understood, is its property of uniting with alkalies, earths, or metallic oxides,

to form some of the very numerous and important class of substances called salts. But by far the greater number of the acids also possess the original characteristic of sourness, and some possess it to a degree highly acrid and even perfectly corrosive; most of them combine in any proportions with water, and, in the act of combining with it, decrease in volume and send out heat; all, with a few exceptions, are converted into vapour or decomposed into simple substances by the action of moderate heat; and very nearly all have the power of changing the purple colours of vegetables into a bright red. Some of the acids, as the carbonic and the chloric, are gases; some, as the sulphuric and the acetic, are liquids; and some, as the tartaric and the citric, are solids. Some are strictly natural products; some are the results of chemical agency; and some are both natural and artificial. Some exist or can be obtained in great abundance; and others are obscure and very rare, or can be obtained only in small quantities and with considerable difficulty. Some, as the nitric, can be retained only in water or in a base; a few are evanescent or very easily decomposable; and many have an independent and very sturdy subsistence.

A classification of acids which has been very generally adopted, distributes them into mineral, vegetable, and animal,—or such as are derivable from respectively mineral, vegetable, and animal substances; but though this classification is facile, popular, and apparently quite clear, and though, for these reasons, it will be adopted in much which we may have to say respecting agricultural chemistry, yet it is neither sufficiently analytical, nor scientifically correct. Another classification distributes acids into such as are simply compound, and such as are doubly compound, or into those which have only one acidified basis, and those which have two or more bases; but this is at once vague in its character, uncertain in its application, and obscure in its comprehension. A much preferable classification, for combining clearness and facility with correctness and comprehensiveness, divides acids into organic and inorganic, and subdivides inorganic acids into such as contain neither hydrogen nor oxygen, such as contain hydrogen, such as contain oxygen with metallic bases, and such as contain oxygen with non-metallic bases. Oxygen is a simple gaseous substance, one of the most pervading and valuable in the world, forming the vital air of the atmosphere, and acting as the chief agent in combustion, and in animal and vegetable decomposition; and this gas received its name of oxygen—which means the generator of acid—from its great power of forming acids by entering into combination with earths and metals, and from its having been originally supposed to be the only substance by which this power is possessed. Hydrogen is another simple gaseous substance, of widely different properties from oxygen, and forming a principal constituent

of water. Now, as many acids are both formed and decomposed in the processes which are constantly going on upon a farm—as some by forming themselves may be drinking up the simple gases, while some by resolving themselves into their elements may be giving off these gases, it becomes useful to know which acids are formed by oxygen, which by hydrogen, which by chlorine or fluorine, which by oxygen with a metal, which by oxygen with some other substance than a metal, and which by an union of chemical and vital action in the intricate organisms of vegetables and animals. Most of the inorganic acids will be sufficiently understood for all the purposes of a farmer, if known simply as belonging to their respective classes, or as formed principally of oxygen and a metallic base, of oxygen and a non-metallic base, of hydrogen and either an earthy or a metallic base, or of elements different from those of the oxygen and the hydrogen acids. Yet several of them act so prominent and exceedingly important parts either in the economy of vegetable life and growth, or in manurial operation upon the soil, or in the processes by which manurial composts are prepared, that they require to be well-known in their individual characters and powers. Carbonic acid, in particular, demands thorough individual notice for its agency in supplying all plants with carbon, one of the very chief constituents of their bulk; nitric acid, for its agency in supplying the cereal grasses and other nutritious plants with nitrogen or azote, a distinguishing element in the composition of their alimentary pulps and juices; phosphoric acid, for its agency in providing nutritious plants with phosphates, an invariable constituent of the seeds of all kinds of grasses, beans, pease, and lentils; and sulphuric acid, both for its immediate power as a manure on some special soils, and for its extensive agency in supplying manurial salts, and in controlling important processes in the preparation or enrichment of farm-yard manures. The organic acids, as a class, are far more compound in their constituents, elaborate in their formation, and numerous in their chemical aspects than the inorganic acids; and as most of them are identified with only a class or a genus, or even a single species of organic substances, they can be properly understood only when individually studied and known. But so large a proportion are either obscure or of very limited existence, or of ill-developed character, or of feeble and unimportant agency, that even a very intelligent farmer may discard them from his vocabulary without risk to either his interests or his reputation. Hence only about four or five of the organic acids, and so many of the organic as either exert an extensive agency, or possess a very distinct character, are requisite topics for discussion in agricultural chemistry.

We shall here name in a note the principal acids, as enumerated in the fourth edition of Dr. Ure's Dictionary of Chemistry; and we may state

that many more have recently been discovered, and that a far fuller list of them, as well as an ample notice of each, may be obtained by consulting the works of Dr. Thomson, which we shall name at the close of this article.* All the organic acids are decomposed by a red heat; most of them yield at once carbon, oxygen, and hydrogen; and a few of them, in addition to these, yield nitrogen or azote. See articles AZOTE, CARBON, HYDROGEN, and OXYGEN. The vegetable acids, in a free or uncombined state, occur very often in fruit, occasionally in leaves, and more rarely in seeds and roots; but, in a state of combination, they are usually met with in almost all parts of plants. The most important of the organic acids named below are the abietic, found in the fir; the aceric, in the maple; the acetic, in numerous vegetables; the amniotic, in the *liquor amnii* of the cow; the amylic in starch, or the farina of plants; the benzoic, in the sweet-scented vernal grass, and sweet-scented soft grass, *anthoxanthum odoratum* and *holcus odoratus*; the butyric, in butter; the caseic, in cheese; the citric, in lemons, oranges, currants, and some other fruits; the formic, in the liquor of ants; the gallic, in most barks; the lactic, in milk or whey; the lithic or uric, in urine; the malic, in apples, and in the berries of the mountain-ash; the oxalic, in sorrel; the pectic, in many vege-

* The inorganic acids which contain neither oxygen nor hydrogen, are the chloriodic, the chlorocyanic, the fluoboric, and the fluosilic; the inorganic acids which contain hydrogen are the fluoric, the hydriodic, the hydrochloric or muriatic, the ferrocyanic, the fluotitanic, the hydrobromic, the hydroselenic, the hydrocyanic, the hydrosulphurous, the hydrotellurous, and the sulphocyanic; the inorganic acids which contain oxygen with metallic bases are the arsenic, the arsenious, the antimonie, the antimonious, the chromic, the columbic, the manganic, the manganous, the molybdic, the molybdous, the selenic, the selenious, the titanic, and the tungstic; the inorganic acids which contain oxygen with other bases than metals, are the boracic, the bromic, the carbonic, the chloric, the perchloric, the chlorocarbonic, the iodous, the nitrous, the nitric, the hyponitric, the hyponitrous, the iodic, the iodosulphuric, the hypophosphorous, the phosphorous, the phosphate, the phosphoric, the hyposulphurous, the sulphurous, the sulphuric, the hyposulphuric, and the cyanic; and the organic acids are the abietic, the aceric, the acetic, the aloetic, the amniotic, the amylic, the benzoic, the boletic, the bombyc, the butyric, the camphoric, the capric, the carbazotic, the caseic, the cedadic, the cholesteric, the citric, the croconic, the delphinic, the ellagic, the formic, the fulminic, the fungic, the gallic, the glaucic, the hircic, the hydroanthic, the indigoic, the ignauric, the kinic, the laccic, the lactic, the lampic, the lithic or uric, the malic, the meconic, the menispermic, the margaric, the melassic, the mellitic, the moroxylic, the mucic, the nanceic, the netro-lentic, the netro-saccharic, the oleic, the oxalic, the pectic, the phocenic, the pinic, the purpuric, the pyrocetic, the pyrolithic, the pyromalic, the pyrotartaric, the rosacic, the sac-lactic, the sebacic, the silvic, the solanic, the storacic, the suberic, the succinic, the sulphonaphthalic, the sulphovinic, the tartaric, and the vegeto-sulphuric.

tables; the silvic, in the pine; the stearic, in saponified fat; and the tartaric, in the grape or in the lees of wine. Three organic acids of important character, not included in the list below, are the tannic, found in such barks as are capable of tanning leather; the humic, constituting the most valuable part of mould or vegetable soil; and the hydrocyanic or prussic, noted for its dreadfully poisonous power, and found in peach blossoms, laurel-leaves, sloe-flowers, and bitter almonds. We shall, in their appropriate places, give brief separate articles on these three acids, on the more important of the other organic acids, and on the nitric, the phosphoric, the sulphuric, and the carbonic acids.—*Ure's Dictionary of Chemistry*.—*Thomson's Chemistry of Organic Bodies*.—*Thomson's Chemistry of Vegetables*.—*Boussingault's Rural Economy*.—*Liebig's Chemistry of Agriculture*.—*Davy's Agricultural Chemistry*.

ACINI. Berries which hang in clusters, as mulberries; also the granules, kernels, or small stones of grapes and other berries; also numerous little granules, dispersed through the substance of the horse's liver, and supposed to assist in separating the blood from the bile.

ACINUS. The annual plant wild basil, very common on dry arable lands in many parts of England, especially on gravelly or chalky hills.

ACNIDUS,—popularly VIRGINIAN HEMP. A small genus of plants, of the goosefoot tribe. The only well-known species is an annual, and a native of North America; it flowers in June and July; and it has lanceolate leaves, and somewhat smooth, sharp-angled capsules.

ACONITE, MONKSHOOD, OR WOLFSBANE—botanically *ACONITUM*. A genus of tall, ornamental, free-flowering, perennial, herbaceous, and very hardy plants, of the ranunculus tribe. The number of known species is about 120. Several of the species are very commonly grown in gardens, and bear a close resemblance, in general appearance of both stem and leaf, to some of the most common species of larkspur. The flowers of the most common kind are dark blue, helmeted, large, and scentless; they are produced in solitary, simple, upright, spike-like panicles; and, when judiciously intermixed with contemporaneous flowers of other genera, they make an imposing figure in a bouquet. But the whole genus, in all the parts of its plants—roots, stem, leaves, and flowers—is poisonous, and ought either to be expelled from garden-culture, or grown only within limited conditions. Any parent who suffers it to grow within the reach of his children is either ignorant, fool-hardy, or florist-mad; and any amateur who is not willing to adopt some of the finest larkspurs as a substitute for it, deserves to be condemned for a season to regale himself on docks and dandelions. The species best known to gardeners are those designated *Napellus*, *alpinum*, *lycoctonum*, *Japonicum*, *pyreniacum*, *ochroleucum*, *album*, *barbatum*, *orientale*, *anthora*, *pyramidale*, *tortuosum*, *cammarum*, and *uncinatum*. The kinds

with blue flowers are believed to be much more poisonous than those with white or yellow flowers; and several are poisonous in the most virulent degree. Every part of the very common species, *Aconitum Napellus*, is poisonous in its green state; yet, when dried and properly prepared, it becomes an useful medicine in fever, rheumatism, schirrus, and other cases, but, of course, cannot be administered with safety except by a skilful physician. The dose of powdered aconite is one or two grains. Externally, as an embrocation, the tincture has been usefully employed in neuralgic affections. It should be applied in this form by means of a small piece of sponge attached to the end of a stick. The root is gathered in the spring before the leaves appear. The leaves are usually collected when the flowers begin to appear. Neither the leaves nor the root have any smell, but when chewed they slowly occasion a sense of tingling and numbness in the tongue and interior of the mouth. Large doses excite symptoms of gastric irritation, followed by stupor, convulsions, coma, and death. A person having eaten some leaves of the plant, and become maniacal, the surgeon who was called to his assistance declared that the aconite was not the cause of his disorder; and, to convince the persons present that the plant was harmless, he eat freely of it, and soon after died in great agony. By far the worst species is the *Aconitum ferox*, sometimes called *Aconitum virosum*, a native of the Nepal mountains, in places 10,000 feet above the level of the sea. Three other species are natives of the same regions, and are known by the inhabitants to be strong poisons. "But this species," says Dr. Wallich, in his recent '*Plantæ Asiaticæ Rariores*,' "exceeds them all in virulence, and is probably the most deleterious vegetable poison of continental India. This dreadful root, of which large quantities are largely imported, is equally fatal when taken into the stomach or applied to wounds, and is in universal use in poisoning arrows, and, there is too much reason to suspect, for the worst purposes."

ACONITE (WINTER). See HELLEBORE.

ACONITIA, or ACONITINE. The chemical base, or active principle, found in the root of the several species of aconite. It is the most virulent poison known; not excepting prussic acid. As prepared by Morson of London, one-fiftieth of a grain has endangered life; and the hundredth part of a grain has produced a feeling of numbness, weight, and constriction which has lasted a whole day.

ACORNS. The seed or fruit of the oak. They were used as food by the early Greeks, by the ancient Britons, and by other primitive tribes of the human race; but those used by the Greeks were much sweeter and more succulent than English acorns are, and those used by the ancient Britons appear to have been gulped down more in obedience to Druidical superstition than under the direct promptings of a regular appetite.

Acorns continue also to be used as food by some of the Spanish peasantry; but, like those of ancient Greece, they must not be judged of by the acorns of England,—and they may be supposed, besides, to be eaten only in consequence of the sheer dearth of better food. An old English writer describes them as very nourishing, but as hard of digestion and tending to create raw humours, and as therefore not proper to be used for food.

Farmers, in various parts of Germany, particularly in some districts of Saxony, successfully employ acorns for the winter-fattening of sheep. English farmers, however, either totally neglect them, or use them almost solely for the feeding and fattening of hogs. In Hertfordshire and in the New Forest district of Hampshire, hogs, in many instances, receive very little other food than acorns, and commonly attain great firmness, fatness, and weight, and yield a decidedly good and well-flavoured pork. Yet such as are, for a short time, withdrawn from the acorn diet, and have their fattening completed by four or five bushels of barley flour or pease meal to each, are judged by some persons to yield pork of still better substance and superior flavour. The farmers of Gloucestershire bestow nearly as much care upon the fruit of their oak-trees as upon the produce of their orchards; they seldom sell their acorns, or can find any in the market, yet usually estimate their value at from 1s. 6d. to 2s. per bushel according to the price of beans; and they regard them as decidedly superior to beans at once for fattening hogs, for increasing their weight, and for rendering their bacon firm.—Hogs fed upon acorns, however, require to be treated with some precaution; for if they are let loose among them at will, or unduly restricted in their liberty and other means of exercise, they either will remain lean and light, or will contract a distemper called the *garget*. Two methods have been recommended for preventing the distemper; the one, to moisten some pease and beans with water, and mix them up with a little powdered and sifted antimony, and to administer a dose or meal of the mixture on every alternate day for two or three weeks; the other, to dig, in a warm place, a hole of several bushels in capacity,—to fill this with acorns, and moisten them well with water, holding in solution a handful or two of common salt,—to let them remain in the hole till they have germinated, and sent out shoots of about three inches in length,—and then to dry them by winnowing in the shade, and employ them, to the exclusion of all unprepared acorns, for the hogs' food. Yet even the prepared acorns must never be given in such quantity as to permit a surfeit; nor must they be given oftener for a day or two than twice a-day, or oftener at any period than three times a-day. But these directions are probably too refined; and certainly seem quite unneeded in the free, heedless, and successful feeding of the New Forest

of Hampshire. A main point there, and perhaps a main point in all acorn-feeding, is not to confine the animals to the sty, but to permit them abundance of liberty and exercise.

The main use of acorns, in all ages and in all oak-growing countries, is the natural one of propagating the oak. Most soils in England, if properly prepared, will suit for the sowing of acorns, but the quality most suitable is a deep, rich loam. Oak which is raised upon prime, deep land is generally more tough and resistive than such as grows upon shallower or drier ground; yet oak grown upon the latter is occasionally much more compact and hard. Land destined for acorns, whatever be its precise quality, ought to be very thoroughly tilled, and somewhat finely pulverized. If it could be made ready against the time of the acorns being ripe, and an efficient protection could be established during winter from the attacks of insects, birds, and mice, the most favourable time for sowing would be the moment in autumn when the acorns are just ripe. But as these conditions rarely exist, or as acorns of the best kind may not be growing in the vicinity, but may require to be procured from a distance, the sowing must, in general, be postponed till spring. Only those acorns ought to be selected for seed which grow upon the choicest individual trees of the choicest varieties of the choicest species of the oak; for though both the best species and the best variety were selected, yet if the individual trees should be deficient in tallness, robustness, and breadth, they would probably transmit some degree of their defects through their seeds to the crop of young plants. Rather let the cultivator incur considerable cost and trouble in procuring seeds from the best trees at a distance, than use seeds from second-rate trees in his vicinity.

"Having provided yourself," says the thoroughly practical Boutcher, in his 'Treatise on Forest Trees,' "with acorns in the autumn, gathered from the handsomest and most vigorous trees, in fair weather, spread them in an airy covered place, and turn them frequently till quite dry; when you find they are so, mix them with sand, or loose light earth, and let them be protected from vermin, frost, and moisture, till about the middle of February. At this time, or as soon after it as the weather will admit, prepare, by a clean digging and raking, a spot of good natural soil; and, to render the crop equal and uniform, try the goodness of your seeds, by throwing them into a tub with water, when the fresh will sink to the bottom, and the rotten or defective float on the surface. The quality of the acorns being thus ascertained, make shallow drills across the ground, with a small hoe, at eighteen or twenty inches distance; and in these drop your acorns, about two inches separate, covering them, with the back of a rake, two inches deep; let the ground be raked smooth, and kept clean and mellow during the summer months. The begin-

ning of April, the succeeding spring, cut them under ground as directed for the beech, and let them remain till the spring after. From this situation, as soon as their buds begin to swell, let them be carefully raised, without tearing their roots or fibres; and ground being ready, separate the straight free-growing plants from the crooked and shrubby; shorten any downright or bruised roots, but be very sparing of the small fibres; and plant the straight trees in one quarter of the nursery, in rows, two feet asunder, and nine inches in the row; and the crooked ones in another, at the same distances: let these plants be as little time as possible out of the ground; for this purpose, raise few of them at a time, and if you have the command of four men, they will suddenly despatch a great number of them, that is, by one man raising the plants, another pruning them, and giving them to the planters, and two planting. If the land is good, and the seasons have been kindly, the straight plants may be removed in two years; but when either of these circumstances is otherways, they may continue three seasons.

"The crooked and brushy trees, having stood two years in the nursery, must be cut over by the ground, and remain two years longer; and observe, that, as soon as their shoots are four or five inches long, you pinch off all but the most promising one; from whence the whole strength and juices of the root will be exerted in the support of this single shoot.—Another method of raising these trees, with equal success, is, sowing the acorns on beds, in rows, seven or eight inches asunder, and two or three inches in the row, covering them the usual depth, and letting them remain only one year. From these beds remove them the following spring, and having shortened their top roots, lay them in lines, cut down perpendicular with the spade, eighteen inches asunder, and eight or nine inches in the line, where they may continue two years. From thence remove them, separating, as has been said, the straight from the crooked, and plant them in different quarters, in rows, two feet and a half asunder, and one foot distance in the row; the straight plants to continue here three years, and the crooked, if they have grown freely, to be cut over in one, but if otherways, not till two years; and here they should remain three years longer."

Some writers recommend that the land designed for the reception of acorns should be disposed in beds each four feet wide, and separated from one another by paths each two feet broad; and others recommend that it should be laid out with the hand-hoe in ridges of four feet in width, two inches in crown height, and separated from one another by open-drain furrows,—that, to prevent the rows of plants from obstructing the flow of the surface-water toward the furrows, the drill-lines for the seeds should be drawn across the crowns of the ridges or at right angles to the furrows,—and that, to allow the land to have the

free action of the surface-drainage as long as possible before the sowing of the seeds, both the ridges and the furrows should be formed a twelve-month before the time of sowing. But some nurserymen seem determined to reject all such niceties, and either to sow the acorns thick and broadcast in small seed-beds with a view to very early transplantation, or to draw their seed-drills upon the natural level of the ground, without any break, from side to side of a whole plot. We have seen instructions for sowing acorns, which seemed to say that, if simply flung from the hand or tossed about by boys and women, they would take care of themselves, and not fail to become proper trees; and these precious instructions appeared to curry favour with short-sighted niggards by telling them that an acre of ground can be sown for five shillings. But if good or even tolerable seedlings are to be raised,—such seedlings as shall embody the young energies and sturdy habits of truly noble oaks, nearly all the care and cost of at once the best soil, the best sowing, and the best culture will be required.

We observe with regret that, even when due tilth and sowing are practised in nursery-grounds, the after culture is sometimes far from being creditable; and we recommend to intending purchasers of young plants, if they have a choice of markets, and if other conditions be equal, to give a decided preference to the nursery-ground whose oakling plots are freest of weeds. As soon as the young plants appear above ground, the soil should be thoroughly loosened and cleaned with the hoe; and as often as the surface is hardened, or a new appearance of weeds is to be seen, the hoeing ought to be repeated. In the spring of the third year of their growth, the plants should be thinned out to the distance of one foot or upwards from one another in the row; and in the spring of their fifth year, they will be in a fit condition for removal to their final situation. Both the cultivator in thinning out, and the purchaser in selecting, ought to reject all plants except such as have a robust stem, a clear bark, and a plump leading bud; for only seedlings which possess these properties are likely to produce trees which will have a noble character, or which will successfully combat accidental injuries, defects of soil, or disadvantages of climate. See articles OAK, PLANTING, and TRANSPLANTING.—*Treatise on Planting in Library of Useful Knowledge*.—*Nicol's Planter's Kalendar*.—*Miller's Gardener's Dictionary*.—*Loudon's Gardener's Magazine*.—*The Society of Gentlemen's Complete Farmer*.—*Boutcher's Treatise on Forest Trees*.

ACORUS,—popularly SWEET FLAG or SWEET RUSH. A small genus of perennial, semi-gramineous plants, of the tribe aroideæ. A grass-leaved species from China was introduced about half-a-century ago, but continues to be little known. The common species, *Acorus calamus*, is indigenous in many parts of Europe, Asia, and America, and grows in open situations, in shallow waters, or on the banks of rivers. It is found wild in

Norfolk, near Uxbridge in Middlesex, and in fresh-water marshes of many other parts of England; and it abounds in most of the ditches and standing waters of Holland. It will not thrive under the shade of trees, but will grow well in any moist part of a garden, yet will not produce its spikes of flowers except when growing in water. Its flowers appear in the end of June, and continue till August. Its roots are the well-known *Calamus aromaticus* of the drug shops, and have long been in reputation as an aromatic and tonic bitter. This substance is used in this country as a simple medicine, by chewing or decoction; as an ingredient in some compound drugs,—particularly compound tincture of gentian; and as a principal medicament in the preparation of the medicated malt liquors called herb ales; and it is used throughout the United States of America for making bitters, and is supposed to be the ingredient used by the French for giving flavour to their snuff called *a la violette*. The whole plant has been used for tanning leather; and in Poland, it is strewed on the floors of the upper and middle classes of society when they are about to receive company, in order that the leaves may be bruised by the feet of the guests, and fill the rooms with an agreeable odour. Its medicinal qualities were, at one time, greatly overrated; and were alleged to be effective for removing obstructions of the liver and spleen, for promoting a flow of urine and the menses, and for resisting putrefaction.

ACOTYLEDONOUS PLANTS. Vegetables which have no seed-lobes in their embryos or rudimental parts of their future plants, or which have no proper seeds, but propagate themselves by means of small granules designated *spores* or *sporesules*. They are supposed to comprise about 8,000 or 10,000 species, or nearly one-fifth of all the plants which exist; and they constitute one of the three grand primary divisions of the natural or Jussieuan system of botany, and nearly correspond to the cryptogamous division of Linnæus, or agamous division of Humboldt. They comprise only the lower grades of the vegetable kingdom, and exhibit, in their outward aspect and internal structure, little of the loveliness of form, the brilliance of colouring, and the complication of organism which distinguish the higher grades of plants. Many of them, as the moulds and noctes, appear to the eye mere slime or mucus; many, as the protococcus and the byssus, consist merely of clusters of minute threads or minute cells; and even those which approach nearest the higher orders in complexity and beauty, are merely the most elegant of the numerous and monotonous tribes of the mosses and the ferns. The great constituent families of acotyledonous plants are *filices* or ferns, *musci* or mosses, *lichens* or minute parasites of trees and stones, *hepatice* or moulds and grassy threads on water, *fungi* or mushrooms, and *algæ* or sea-weeds. But even the most minute, neglected, and seemingly in-

significant of these classes, or of the genera which they comprise, are far from being useless in the economy of providence and of organic existence. "They serve to complete and to keep up the integrity of the vegetable creation, whether it be by decomposing putrid and fecal matters, or by preparing a soil fit for vegetables of a higher order. They are scattered over all climates and all quarters of the world, replenishing both earth and sea with vegetable life, and ascending even into the regions of the air by the very levity of their seeds, spores, or bulbules, to be wafted on the winds, till, drenched with moisture, they descend again towards the earth, ready to cling to the soil that suits them, if it should be even the surface of the flinty rock, or to spread themselves over mountains of eternal snow, or to immerse themselves in the waters of the ocean. Thus many of the algæ [lichens] at least, sow their seeds and thrive where no other plant would live. They grow up, come to maturity, and perish where they grow, forming, in process of years, a soil of some depth. First mosses, and then ferns, are found to follow in their train, leaving a soil deeper and richer still, till at last, in the revolution of ages, the very surface of the barren rock is covered with a soil capable of supporting the loftiest trees."—*Keith's Botanical Lexicon*.

ACRE. The standard measure of land throughout Great Britain and Ireland. The imperial acre, or English statute acre, comprises 4 roods; one rood comprises 40 square perches; one square perch comprises $30\frac{1}{4}$ square yards; and one square yard comprises 9 square feet. Hence the lineal measure, whose squares constitute the fractions or subdivisions of the acre, is inversely expressed thus,—three feet make one yard, and $5\frac{1}{2}$ yards make one perch. The English standard acre, now the imperial acre of Britain, is a square raised from the basis of the chain of 66 feet or 4 perches: ten of these squares forming the acre, which thus contains 4,840 square yards. By the act 5^o Geo. IV. c. 74, the imperial acre is declared the standard throughout the United Kingdom from and after May 1st, 1825. But the establishment of the imperial acre as the standard or only legal measure of land throughout the United Kingdom, was afterwards, by 6^o Geo. IV. c. 12, fixed for January 1, 1826; and it is still very far from being uniformly recognised in practice. The length of the linear perch, in the measure of most of Devonshire and part of Somersetshire, is 5 yards instead of $5\frac{1}{2}$; in the measure of Cornwall, 6 yards; in that of Lancashire, 7 yards; in that of Cheshire and Staffordshire, 8 yards; and in that of the Isle of Purbeck and some parts of Devonshire, 15 feet and 1 inch;—and the acre, in all these cases, corresponds to the squaring of the perch, and differs in corresponding degrees from the imperial acre. In the tenantry fields of Wiltshire, and some parts of the adjacent counties, an acre formerly consisted of only 120 square perches or 3 roods; and in many parts of Wales, the com-

mon acre was equal in area to two English acres. The acre in Scotland is equal to 1 acre, 1 rood, and nearly 2 perches of English measure; and it comprises 4 roods, while each rood comprises 40 square fells, each fell 36 square ells, and each ell 9 square feet and 73 square inches. It is raised from the chain of 24 ells; and until of late years it was the practice of land-surveyors to measure with a chain of 74.4 feet in length; the ell having been erroneously estimated at 37.2 inches. Hence the Scots acre came to be about 6,150 square yards. The proportion of the Scots acre to the imperial acre is as 1.26118345 to 1. A Scots rood is equal to 31530 parts of an imperial acre; and a Scots ell to 1000219 parts. In Irish measure, 64 plantation acres are equal to 49 in forest measure; 625 plantation acres are equal to 784 Conyngham acres; 36 plantation acres are equal to 49 woodland or Burleigh acres; 121 plantation acres are equal to 196 imperial acres; and 1,369 plantation acres are equal to 1,764 Scottish acres. Hence 1 plantation acre—or, *par excellence*, Irish acre—is equal to 3 roods and $2\frac{1}{2}$ perches of forest measure; to 1 acre, 1 rood, and seven-tenths of a perch of Conyngham measure; to 1 acre, 1 rood, 6 perches, and one-tenth of a perch of Scottish measure; to 1 acre, 1 rood, 17 perches, and four-fifths of a perch of woodland measure; and to 1 acre, 2 roods, 19 perches, and one-tenth of a perch of imperial measure. On the grounds already stated also, 100 imperial acres are equal to 120 acres, 3 roods, and 20 perches of Devonshire measure; to 119 acres, 2 roods, 26 perches of the Isle of Purbeck measure; to 84 acres and 4 perches of Cornish measure; to 47 acres, 1 rood, and $2\frac{1}{2}$ perches of Cheshire and Staffordshire measure; to 133 acres and 2 roods of Wiltshire tenantry measure; to 79 acres, 1 rood, and $6\frac{1}{2}$ perches of Scottish measure; and to 61 acres, 2 roods, and $37\frac{1}{2}$ perches of Lancashire or Irish plantation measure.—Surveyors, in measuring land, use a chain, 4 perches in length, and divided into 100 equal parts called links; and they make their computations in chains and links, but exhibit the result in acres, roods, and perches,—10 square chains, or 100,000 square links constituting an acre. A square mile comprises 640 imperial acres; and a hide of land, mentioned by writers of former times, comprised 100 acres. The Strasburg acre is equal to about one-half of an English acre; and the French acre, or arpent, comprises 51.691 English square feet, and is therefore nearly equal to one English acre and three-fourths of an English rood.

In 1820, the commissioners on weights and measures reported, that the following customary acres were in use throughout England:

Bedfordshire: Sometimes 2 roods.

Cheshire: Formerly, and still in some places, 10,240 square yards.

Cornwall: Sometimes one of the Welsh acres of 5,760 yards.

Dorsetshire. Generally 134 perches.

Hampshire: From 107 to 120 perches, but sometimes 180.

Herefordshire: Two-thirds of a statute acre. of hops, about half an acre, containing 1,000 plants.

of wood, an acre and $\frac{1}{2}$ or 256 perches.

Leicestershire: 2,308 $\frac{1}{2}$ square yards.

Lincolnshire: 5 roods, particularly for copyhold land.

Staffordshire: Nearly $2\frac{1}{2}$ acres.

Sussex: 107, 110, 120, 130, or 212 perches.

Short acre, 100 or 120 perches.

Forest acre, 180 perches.

Westmoreland: 6,760 square yards, or 160 perches of $6\frac{1}{4}$ yards square; in some parts the Irish acre is used.

Worcestershire: Hop acre, 1,000 stocks, or 90 perches; sometimes 132 or 141 perches.

N. Wales: *Erw*, or true acre, 4,320 square yards; *stang*, or customary acre, 3,240 square yards, as in *Anglesey* and *Carnarvonshire*, making $5\frac{1}{2}$ *llathen* = 160 perches W. of $4\frac{1}{2}$ yards square, called *paladr*; 8 acres making an *ox-land*, and 8 of these a *plough-land*, in *Pembrokeshire*.

The term *acre* sometimes denotes a measure of length; and, in this sense also it varies considerably in different districts of England. Thus in

Bedfordshire, } a chain of 4 poles, or 22
Buckinghamshire, } yards.

Derbyshire, 4 "roods," each of 7 or of 8 yards.
Yorkshire, 28 yards.

ACRE-DALE. A term sometimes met with in old Scottish deeds and writings, signifying lands in the neighbourhood of towns or villages which were let in small portions of about an acre in extent.

ACREME. Ten acres of land.

ACRIMONY. A sharpness or extreme acidity in numerous plants. This property is of very various kinds and degrees; and appears to be identified chiefly or perhaps wholly with acids and volatile oils. In some plants, as in the common nettle, and in some of the mushrooms, it is so pungent as to excoriate or blister any part of the body to which it is applied; and in others, as in several of the poisonous plants, it is, in a considerable degree, astringent and corrosive. In some, as in nettles, onions, and water-cresses, it is greatly modified by the culinary application of heat; and in others, as ginger, capsicum, and pepper, it is rather stimulated than mollified by the action of heat. Unless the nature of any plant be very well known, the presence of acrimony in its juices ought to inculcate extreme caution in using it.

ACROSPIRE. The shoot or sprout from the end of grain seeds, when germinating under the malting process. See **MALT**.

ADAM'S APPLE. The fruit of the plantain-tree, *Musa paradisiaca*.

ADAM'S NEEDLE,—botanically *Yucca*. A very curious genus of tulipaceous, evergreen, exotic, garden shrubs. About twenty species, besides some varieties, have been introduced to Great Britain, principally from North America. The superb species, *Yucca gloriosa*, in both its form and its manner of flowering, is a sort of

rude and reduced copy of the wondrously magnificent American aloe.

ADANSONIA, — popularly SOUR GOURD. An evergreen tree of the silk-cotton-tree order; and the bulkiest in stem known to botanists. It is a native of Congo in Africa, and grows there to so enormous a bulk as to be the vegetable wonder of the world, yet does not attain a remarkable size under European culture, nor even in the open grounds of countries adjoining Congo. Mr. Adanson, whose name it bears, was a celebrated French botanist, who resided for some years in Senegal as a surgeon, and who discovered the tree, sent home seeds of it to Europe, and made measurements of several specimens of it on the spot. The trees which he measured were remarkable, not for height or for a spreading body of foliage, but for their vast mass of solid or dendritic matter; their stems had a circumference of from 65 to 78 feet; their branches deflected in great numbers, and somewhat horizontally from the trunks, at the height of from 12 to 15 feet from the ground, and were from 40 to 45 feet long, bending at their extremities to the ground, and each equal in bulk to an enormous tree; and their roots, so far as they could be traced in places where they were laid open by a stream, were ascertained to be 110 feet in length, exclusive of portions which remained covered. The stem of the *Adansonia* is woody, but of soft texture, and has a large swelling near the root. The leaves toward the lower part of the young branches are single and spear-shaped; but those at the extremities are three-lobed or five-lobed, and spread out like a hand. The fruit is large and oval, with a hard shell like a gourd; and the seeds are lodged in a soft pulp, and are dark in colour, and shaped almost like the nuts of chocolate. The natives use the fruit-shell as a culinary vessel; they manufacture the fibres of the bark into ropes and coarse cloth; and they use the small leaves for food in times of scarcity, and the large leaves for thatch to their houses or for incineration to be manufactured into soap. Seeds of the *Adansonia* were sown in several gardens of England in 1724; and the young plants grew to the height of 18 feet; but in the severe winter of 1740, all were destroyed. The tree is called by the natives *baobab*, and by botanists *Adansonia digitata*. A great many plants of it have recently been grown in some parts of the United States of America.

ADDER or COMMON VIPER—zoologically, *Vipera vulgaris* or *Vipera communis*. A well-known venomous serpent, the terror of many a farm and parish, in various districts of England and Scotland. It occurs in most countries of Europe, and abounds in all the chalk districts of England, in some parts of Yorkshire, and in numerous parts of both the lowlands and the highlands of Scotland. It prefers dry woods, sandy heaths, dry moors, peaty lands, sunny banks, small bogs, old dry stone-fences, and similar localities. Several

varieties of it are met with, so different from one another as to have been regarded by some naturalists as different species,—such as the black viper, the common viper, the red viper, and the blue-bellied viper; but all have been ascertained to possess strictly one specific character. The adder, though justly an object of aversion and dread, is by no means so noxious a creature as is commonly believed. It never makes an unprovoked attack; but is induced to bite only when suddenly molested, or when obliged to act in self-defence. The chief danger to any person walking in its vicinity consists in coming close upon it, and appearing to intend it damage, while it is unobserved. Its bite, too, though quite painful and venomous enough to be matter of serious apprehension, is exceedingly far from being necessarily fatal; and probably may, in every instance, with a due degree of care, be somewhat easily cured. In a moss in the neighbourhood of Bucklyvie, in Scotland, a farm-servant, while engaged in cutting peats, a few years ago, was stung by an adder, and died in consequence of the wound in about ten days. The first precaution to be observed in a case of this kind, is, when the disposition of the parts will permit, to fix a ligature above the wounded place, and not to tighten it too much, for fear of giving rise to mortification. Immediately after, a cupping-glass is applied on the wound, the parts adjacent being first scarified; and this mode, highly praised by Celsus, has very recently been attended with happy results in the hands of Messrs. Mangili, Barry, and Bouilland. This method, from analogy, affords an additional recommendation to employ the plan of suction, which has received the further confirmation of professional experiments tried by a number of physiologists and physicians. When the cupping-glass has performed its office, the lips of the wound, already scarified, should be cauterized deeply and extensively. This should be done with a red-hot iron, chloride of antimony, or concremented potassium. A variety of different substances, taken internally, has been lauded from time to time as efficacious against the bite of the viper. Sudorifics have been especially recommended. Fomentations of warm vinegar, an aqueous solution of sal ammoniac, or a solution of sugar-of-lead in water, with the addition of a little camphorated spirit, may be applied when horses or dogs have been bitten by vipers. In ordinary cases relief will be afforded by applying salad oil to the injured part, and also giving it internally. The name adder, by which the viper is popularly known, appears to be a corruption of the reptile's name in the language of the Welch or of the ancient British.

ADDER'S TONGUE—botanically *Ophioglossum*. A genus of ferns, comprising one indigenous species, six cultivated exotic species, and about six unintroduced exotic species. The indigenous kind, *Ophioglossum vulgatum*, is the type of a

tribe of ferns, comprising two other genera ; and it occurs in moist meadows throughout England, and is popularly believed to possess several medicinal virtues. It is found in the months of April and May. Its stem rises four inches from the ground, and its seed-spike four inches from the stem ; but the whole plant is usually so concealed among the grass as to escape the notice of a careless observer. Its seed-spike possesses some resemblance of form to the tongue of the adder ; and has procured for the plant its repulsive name. Its leaf is single, oblong, smooth, thick, unveined, and of a bright green colour. Its root is fibrous. A balsam or salve made out of a trituration of the leaves, has been used for healing green wounds,—though a bit of wax-cloth is probably worth fifty cart-loads of such old-wifish preparations ; the expressed juice of the leaves, drank with horse-tail water, has been recommended for the cure of internal wounds,—though this too smacks of quackery ; an ointment made of the leaves with lard, is proclaimed of excellent virtue for ulcers, burns, hot tumours, and exterior inflammations,—though most of the virtue is probably in the lard ; an infusion of the leaves, or a decoction of the whole plant, is said to be a good drink in fevers, and a cooling and strengthening eye-water,—it may be so, but we should not like to try ; and a fine powder of the whole of the dried herb is recommended to be both taken inwardly and applied outwardly in cases of rupture,—nearly all twaddle and tom-foolery !

ADDLED EGGS. Eggs which are unhatchable, and which become rotten under the hen. The epithet *addled* or *addle* is used by farmers in some parts of England in the broad sense of unproductive, and is applied to any barren or infertile object.

ADDUCTION. The action by which parts are drawn towards the axis of the body. The muscles which execute this particular function are called *adductors*.

ADEPS. Hog's lard, as used in medical or veterinary practice. It is tasteless, inodorous, and free from every stimulating quality ; and, with great propriety, forms the basis of most of the ointments now in use. But often, when compound unguents are applied, mere lard would be preferable ; and very often, an oleraceous leaf, a piece of wax cloth, or any thing which would exclude dirt and air, would be best of all. For remarks on lard, in other than a medicinal point of view, see the article on *Fat*.

ADHESION IN PHYSICS. One of the forces of attraction, called also heterogeneous attraction, to distinguish it from homogeneous attraction or cohesion ; for the latter is exerted between similar, adhesion between dissimilar particles of matter. A piece of glass plunged into water and again drawn out retains a portion of water on its surface, is wetted by it, while glass or iron plunged into mercury do not exhibit a similar result ; the former shows that there is adhesion between the glass and water, but there is little

or none between the two metals, or it is overcome by superior cohesion of iron for iron and mercury for mercury.

Adhesion exerts considerable influence in chemical operations ; thus solution, filtration, alloying, cementation, &c., are all, more or less, subject to its control. The union of two different bodies, by a cement, exhibits this force ; thus when two pieces of wood are joined by corresponding surfaces by the intervention of soft glue, the latter hardens, and draws the surfaces together. In the same way porcelain is united by albumen and lime, bricks and stones by mortar, and the adhesion is often so great that the pieces united will suffer fracture in another direction than in the place of adhesion. Adhesion is often a troublesome interference in chemical operations. Many precipitates adhere so firmly to a glass vessel, that friction will scarcely remove them, it being often necessary to redissolve and reprecipitate them to obviate the difficulty. The adhesion of fatty bodies to almost every kind of surface renders operations with them tedious and annoying. On the other hand, we may avail ourselves of this force in many cases ; thus to prevent a liquid from running down the outside of a vessel while pouring, the lip may be greased, which, for want of adhesion between the fat and the liquid, keeps the latter in one stream by its cohesive force, and to insure this more certainly in quantitative analysis, a glass rod or tube is laid on the lip, which, by adhesive force between it and the liquid, gives direction to the current. The attraction of moisture from the air by powders and porous substances, has considerable effect on their weight, and hence a powder should be finally weighed just as soon as cool, or cooled over sulphuric acid, &c. It is a point of the highest importance in organic analysis, where the content of hygrometric water may entirely change the formula of a substance, since it would give more water and consequently less carbon, &c.

The operation of filtering is dependent on the same force as exerted in capillary attraction, the liquid passing through the pores of paper, &c., independently of pressure, and collecting on the underside in drops, by cohesion. See *FILTRATION*.

Solution of solids in liquids exhibits this attraction and its limits ; thus, if a piece of loaf-sugar be immersed in water by one small point of contact, the water will rise into its pores with some rapidity, until the saccharine cement holding the crystalline particles together is dissolved by the continued exertion of this action, when the mass crumbles and the liquid is saturated. In the solution of sugar, salt, &c., we may conceive the particles of the solid spreading out into spaces between the particles of the liquid, as high as adhesion, diminished by gravity, will allow, and thus a stratum of the solution will remain on the bottom of the vessel, until, by mechanical mixture, they are spread through the liquid, and retained there by adhesive force.

That there is a limit to the exercise of adhesion, is evident from the phenomenon of a saturated solution. Thus the adhesion between water and a salt goes on destroying the cohesive force of the latter, until the two opposing forces are nearly balanced, when suddenly there is a cessation of solution, and the liquid is said to be saturated. See SOLUTION.

The effect of adhesion between gaseous bodies and solids is often of influence; thus when, fine particles of iron, lead, &c., are thrown on water, the portion of air adhering to their surface is so great as to prevent their sinking until they have accumulated so that their gravity is superior to the buoyancy of the air. For the interference of the adhesion between air and glass, see BAROMETER. It is believed that the adhesion of vapour of water to glass interferes with its evaporation, as steam escapes more freely from metallic surfaces. In the weighing of gases, after the exhaustion of the air in the flask, the gas to be weighed should be admitted several times in order to expel all the atmospheric air, for there can be no doubt that its adhesion to the glass tends to retain a portion, and to alter the exact weight of the gas.

The attraction of aqueous vapour from the air by some animal and vegetable substances, has led to their adoption to measure the hygrometric condition of the air. See articles HYGROMETER, HYGROSCOPE.

The force of heterogeneous adhesion might be measured in many instances, if other forces and circumstances did not modify and diminish its action; we may, nevertheless, approximately determine it. Thus, if a dry plug of wood be tightly fitted into one end of a stout tube of glass or porcelain, and a projecting portion be allowed to dip into water, the wood will swell by the entrance of the liquid into its pores so as to burst the tube, though capable of resisting a pressure of more than 700 lbs. to the square inch. This force is also applied to split rocks, holes being bored into them, which are rammed with dry wooden wedges and moistened, so that, by swelling from capillary action, the wood splits the rock in the required direction.

The interfering forces are gravity, cohesion, &c. The solution of salt, &c., in water is opposed by both, the latter more than the former. Heat generally assists adhesion in the case of solution, solids dissolving usually in larger quantities of a heated than a cold liquid. This effect may arise from the fact that heat is an antagonist force of cohesion. On the other hand, heat may diminish it, as in certain solutions (sulphate of soda), &c., or we may destroy the force, as in evaporating a solution to recover a dissolved solid, in distilling where we collect the liquid without the solid. Cold may likewise be employed to separate a solid from solution. See ATTRACTION.—Booth's and Boye's *Encyclopedia of Chemistry*.

ADHESIVE INFLAMMATION. That kind

of inflammation which terminates by an adhesion between inflamed and separated surfaces. When the lungs, bowels, &c., are highly inflamed, their external coats are glued, as it were, to the adjacent membranes lining the chest or belly, and thus adhesions are formed.

ADIANTHUM. See MAIDENHAIR.

ADLUMIA. A tall climbing annual, from North America, and of the fumitory tribe. It is chiefly remarkable for covering a large space in the course of a summer.

ADONIS, or PHEASANT'S EYE. A small genus of common, hardy, flowering plants, of the crow-foot tribe. Three annual species, and one perennial, are well known in even villa and cottage gardens; the former called *Adonis autumnalis*, *estivalis*, and *flaminea*, and the latter called *Adonis vernalis*. Two other species have been introduced; and about eight species continue to be unknown in Britain. One of the annual kinds grows naturally in Kent, particularly on the banks of the river Medway, between Maidstone and Rochester; it abounds there in fields which are sown with winter-wheat; and though it is rarely seen in fields sown with spring-corn, yet if these fields are in lea or grass the next year, it then appears in great profusion. The flower, when fully expanded, has some resemblance to a drop of blood surmounting the leaves of carrots; and, a number of years ago, it was carried in great quantities to the markets of London, and sold in the streets, under the name of red morocco. The annual kinds, when either self-sown or artificially sown in autumn, bloom in the beginning of June, and mature their seeds in August and September; and those sown in spring bloom in July or August, and mature their seeds in October. They grow in almost any situation, but thrive best in a light soil; and they may be procured in a succession, not only by sowings at different periods, but by sowings in different soils and exposures, some in the shade and some in open ground. The perennial adonis is a native of the mountainous districts of many parts of Germany, but has been very long naturalized in the gardens of Britain. It has an annual stem, though a perennial root; it carries a yellow flower; and it blooms in the end of March or beginning of April, and matures its seeds in August. The roots of the adonis are used by the Germans for black hellebore; the seeds, bruised and given in wine or beer, have been recommended for stone and colics; and a hot infusion of the whole plant has been administered for promoting a gentle perspiration. But possibly its alleged properties as an antispasmodic and a diuretic belong rather to the wine with which it is mixed; and its alleged properties as a diuretic to the hot water in which it is administered.

ADOXA. See MOSCHATEL.

ADULT. A full-grown animal. In man, the term is used to denote the age succeeding adolescence, and preceding old age.

ADULTERATION. The mixing of cheap foreign substances with articles of food and medicine, in order that purchasers may be deceived, and large profits obtained. Many farmers, millers, provision-dealers, bakers, dairymen, grocers, confectioners, and druggists, are very unscrupulous adulterators; and, just because they traffic in the commodities which most nearly affect human health and life, they are incomparably guiltier in the sight of God than adulterators of any of the other classes of society. An adulterator of food is at best a robber of the poor, and a cheat in general society; and, in most instances, he is also in some degree—occasionally in a very dreadful degree—a secret stabber at the life of his fellow-creatures,—an unsuspected, a well-disguised, and therefore an eminently guilty poisoner of his fellow-men.

Grain of inferior quality is sometimes mixed with superior; and the grain of the stock is often worse in itself, or less clean, than the grain of the market sample. The butter of the interior or lower part of a cask or other vessel, is sometimes much inferior to that at the top. The milk of town and city dairies, retailed to the families of citizens, is often diluted with water, and sometimes abominably medicated with watery preparations of chalk. Ground pepper from the grocer can scarcely ever, if at all, be obtained genuine; mustard often contains a mixture of insipid substances; and tea is not unfrequently a coarse mixture of home and foreign leaves. Most kinds of comfits, or articles of confectionary, very generally contain a mixture of gypsum, chalk, or other substances, very debilitating to the stomach, and fitted to form obstructions and concretions in the bowels. Ales, wines, and other stimulating drinks, very often as sold in retail, and frequently even as sold in wholesale, contain a large proportion of very deleterious and even directly poisonous ingredients. Drugs—though they ought above all things to be genuine and of the best qualities, and though adulterations of them almost necessarily defeat all medical prescription, and occasion slight attacks of disease to be mortal—are, as a class of substances, probably more adulterated than any other; and not only are feeble and worthless mixtures sold in name and stead of active compound medicines, but vile manufactured imitations are vended in lieu of powders, gums, and other simple substances. The rascality which carries on adulteration in all these departments, and in hundreds of others—which, in fact, keeps up a laboratory of evil at almost every source of supply for the public markets, for the shops, or for the daily wants of man—is far too extensive in its range, and too subtle in its operations, to be investigated and exposed within our narrow limits. All we can do is to exhort farmers, by the highest consideration, to keep themselves uncontaminated by so great a wickedness, and to warn them against being imposed upon in making their own purchases for

the family and the farm. Two important matters in which they incur some risk of being made victims, are those of doctored seeds, and of worthless imitations of guano; and these, as well as some other matters, will be noticed under the words SEEDS and GUANO, and in some other articles. One exceedingly important matter, connected with farm-produce, in which the public are extensively victimized, is the adulteration of flour; and this we shall here briefly notice, both on its own account, and for the sake of giving a specimen exposure of adulterations in general.

“It has been found so difficult,” says Mr. Babbage, “to detect the adulteration of flour, and to measure its good qualities, that, contrary to the maxim that government can generally purchase any article at a cheaper rate than that at which they can manufacture it, it has been considered more economical to build extensive flour-mills, and to grind their own corn, than to verify each sack purchased, and to employ persons in continually devising methods of detecting the new modes of adulteration which might be resorted to.” A mixture of gypsum or of ground bones with flour is not a little noxious, but, if in considerable quantity, may be detected by the disproportion of the bulk of the flour to its weight, and if in only small quantity, may be detected by their incombustion, or remaining as white heavy powder, when a little of the flour is burned. The mixture of potato-starch, and of bean-flour and pea-flour, with white-flour is very extensively practised; and, though quite unlike the poisoning kinds of adulteration, it deteriorates quality, diminishes amount of nourishment, acts directly as a fraud, and is therefore essentially wicked. If a vessel which contains exactly one pound of pure wheat-flour, have put into it a compound of a mixture of wheat-flour and potato-starch, it will be found unfilled to nearly the quantity of potato-starch employed; or, rather, a vessel which contains exactly one pound of pure wheat-flour, will contain $1\frac{1}{2}$ pound of potato-starch, or $1\frac{1}{4}$ pound of equal parts of flour and starch. A few drops of nitric acid will change the colour of wheat-flour into a fine orange yellow, but does not alter the colour of potato-starch. Strong hydrochloric or muriatic acid changes the colour of wheat-flour into a deep violet, but reduces potato-starch into the condition of a liquid. Wheat-flour absorbs a greater proportion of water than potato-starch; so that a comparison of the quantity of water taken up by a genuine specimen of flour, and a potato-adulterated one, will show their character, and indicate the proportion of starch employed. When boiling water is poured upon a mixture of wheat-flour with the flour of either beans or pease, the presence of the latter is instantly announced by the smell of beans or pease in the vapour. A little of the solution of gum guaiacum in water, if poured upon pure wheat-flour, will change its colour into blue, but will be resisted in its colouring action by most foreign

substances. If a few drops of nitrate or muriate of barytes be let fall upon a watery paste of bread containing alum, a white heavy powder will be disengaged, and thrown down as a precipitate. If a breakfast knife heated nearly to redness be thrust into a new genuine loaf, and immediately drawn out, it will be very nearly clean; but if thrust into a new loaf containing a mixture of potato-starch, it will, when drawn out, be thickly skinned or covered with feculæ.—*Babbage on the Economy of Machinery and Manufactures.*—*Thomson's Vegetable Chemistry.*—*Ure's Dictionary of the Arts.*—*Accum on Adulterations of Food.*

ADVERTISEMENT. A term generally applied to any specific intimation in the newspapers, or by handbills or placards, with respect to sales, bankruptcies, the exercise of statutory rights, the publication of books, the leasing of farms, the sailing of vessels, &c. Public notifications of this kind are necessary, under various statutes, in the cases therein prescribed; and the neglect of such public advertising is fatal to the progress of the measure contemplated. Some advertisements, such as those of public carriers, ship and canal companies, being of the nature of offers, are completed as regular contracts by the delivery of goods for transmission in terms of the notification. A duty to Government of 3s. 6d. was formerly chargeable upon every advertisement published in any newspaper or periodical work; but this duty was, by 3^d and 4th Will. IV., cap. 23 (June 28, 1833), reduced to 1s. 6d. in Great Britain, and 1s. in Ireland. This duty produced as under, in 1840—1843,

	1840.	1841.	1842.	1843.
England,	£106,904	107,527	103,386	105,172
Scotland,	14,518	14,217	13,671	13,668
Ireland,	10,167	9,859	9,320	8,990

ADVOWSON. A term used in England, to denote the right of presenting to a vacant living in the church, synonymous with the word *patronage* which is used in Scotland. The bishop had originally the right of nominating to all vacant benefices; but when the opulence and piety of some individuals prompted them to become the founders of churches, the bishops willingly permitted them to appoint persons to officiate, reserving to themselves the right of judging of their qualifications for the office. An advowson is said to be presentative, when the patron presents a person to the bishop to be instituted in the living. It is said to be collative, when the bishop presents, either as original patron, or from a right devolved upon him by the negligence of the patron in presenting at a proper time; and it is said to be donative, when the patron by a single donation in writing, puts the presentee in possession, without presentation, institution, or induction.

ADZE. An edge-tool of the axe kind, but with its edge placed at right angles to the handle. It is much used by coopers and carpenters; and ought to have a place in the tool-room of a farm.

ÆCIDIUM. A genus of minute parasitical fungi, of the hypodermii division of the euto-phyti class. About seventy-five species have been described by botanists; and nearly one-half of these are found on plants growing in Great Britain. A number of the species infest several valuable plants, and produce some kinds of the disease popularly called mildew. Twenty species may be seen figured on pp. 1044—1046 of Loudon's Encyclopædia of Plants, and thirty-three species are noticed in the last edition (1839) of his Hortus Britannicus. The fungi of the genus *Æcidium*, and those of the allied genera *Uredo* and *Puccinia* are formed in the interior of the stems or leaves of plants, and protrude themselves thence to the exterior when ripe; and they are far more fatal in their presence and effects than either the class of fungi which attack only the roots of plants, or the class which lie or grow on the surface of leaves, and which probably derive their chief nourishment from the atmosphere. The *Æcidia*, however, have very generally been confounded with the two allied genera, particularly with the *Puccinia*; and as they really attack different kinds of plants from these, and produce distinctively different effects, they require to be carefully distinguished.

The *Æcidium pini* is found on pine trees. When seen through a magnifying glass, it has the appearance of a number of nine pins; and when it is ripe, it bursts its cuticle, and emits a bright orange-coloured powder, consisting of its spores or granular embryos of future plants.—Another *æcidium*, popularly called the pepper brand, infests barley, and sometimes occasions great loss to the farmer; it gradually consumes the substance of the grain, and deposits in its place a dark-coloured and offensively-flavoured powder; and it decidedly differs from the *Uredo segetum*, which produces what is called smut, and infests not barley only, but also oats and wheat.—The *Æcidium berberidis* infests the berberry tree, and has very generally but quite erroneously been supposed to be communicated thence to corn. When seen through a magnifying glass, it appears to consist of a number of small orange-coloured cups, with white films over each; and when ripe, the films or lids burst, the interior of the cups is seen to be occupied with a number of little boxes or compartments containing spores, and the tops of the cups assume a ragged or uneven appearance. The strong apprehension which multitudes of farmers entertain of mildew being communicated from the berberry to corn, arises from the vulgar error of confounding the *Æcidium berberidis* with the *Puccinia graminis*.

The *Æcidium cancellatum* infests pear-trees, is a most destructive fungus, and has occasioned much speculation among gardeners and naturalists. It first appears like mucus, but afterwards is found to consist of a number of hairy-looking substances; and these substances, when magnified, appear like a collection of bulbous granules,

each containing a number of balls connected by strings; while the balls, though so minute as to be scarcely visible by the naked eye, are ascertained to be the receptacles or depositories of the spores. The veins of the leaves of the pear-tree are always observed to be the first seat of this fungus; then the leaves become yellow and fall off; next the branches wither and die; and perhaps, in the course of two or three years, the whole of the orchard around an infected tree is attacked and destroyed. Leaves overpowered by the æcidium cancellatum are hideous objects. Their natural verdure has given place to a dark brown colour; their upper surface, within the embrowned portions, shows orange-coloured blotches; and their under surface, immediately beneath the blotches, shows softly wooded excrescences, projecting pale brown teat-like bags, more than a quarter of an inch in length, and closed at the mouth; and these bags or peridia are the depositories of the spores. Mr. Sowerby remarks, "*Æcidium cancellatum* has long been a troublesome parasite in many places, and has been the cause of much loss as to the trees which it attacks, as well as in expensive and useless attempts to get rid of it. I think, however, its very nature, like the dry rot, bespeaks an easy cure." Yet he appears to be able to offer no better a prescription than one founded on the theory that the fungus grows only in a certain degree of heat and moisture, and that this degree is capable of being observed and noted; and he would, therefore, be utterly baffled by the theory which seems now to have the general suffrage of naturalists, that the spores of æcidium, as well as of other genera of fungi, are disseminated in the soil, and taken up into the interior of plants by absorption through the spongioles,—and that, in consequence of this, when soil is once fouled with spores, no matter what may be the culture, plants are liable to be attacked with mildew, especially with that of the æcidia and the puccinæ, in the exact proportion of their healthiness and vigour.

The *Æcidium grossulariæ* attacks gooseberry bushes, spreads with rapidity, and resists most efforts for its extinction.—The *Æcidium cornutum* attacks the mountain ash, and makes similar progress to that of the *Æcidium grossulariæ*.—The fungus which attacks the sycamore maple tree, appears like a spot or little nodule of minute oblong bodies, individually of purplish colour, aggregately of blackish exterior, but yellow in the inside, and containing tubes filled with seeds.—The *Æcidium quadrifidum* attacks the *Anemone coronaria* renders its appearance pale and sickly, and generally prevents all or part of it from producing flowers. Spots of a light colour on the under surface of the leaves, first indicate the presence of this fungus; the spots soon become small tuberculate membranaceous bodies, or peridia; and these peridia protrude themselves through the epidermis of the leaves, and, though at first closed, they afterwards open

into four, five, or more broad, reflected segments, and permit the spores which they had enclosed to make their escape. The *Æcidium leucospermum* attacks the *Anemone nemorosa* and differs from the *Æcidium quadrifidum* in being of smaller size and lighter colour, and in opening into a greater number of reflected segments.—The *Æcidium fuscum* also attacks the *Anemone nemorosa*; and it grows on the under surface of the leaves, and gives them somewhat the appearance of fructifying ferns.

The *Æcidium laceratum* attacks the hawthorn, and has been known to destroy a large portion of a hawthorn hedge. A minute point, such as might be made by the puncture of an insect, is the first appearance of the fungus; but this gradually swells into a protuberance of comparatively large size, covered with minute peridia, containing the spores of the plant. The protuberances occur chiefly about the middle of the young shoots of the hawthorn, but sometimes toward the extremity of the young shoots, and frequently in the leaves; they vary in number on each young shoot from one to three or more; they generally have an oval shape, but are often singularly curled and distorted; they vary in bulk from the size of a bean to that of a walnut; they have sometimes a smooth but generally a brown shaggy exterior; they are covered with numerous and crowded orifices, so minute as to be visible only through a magnifying glass, and each surrounded with many mimic leaves, and containing the spores of the fungus; and their interior is solid, and without any appearance of being inhabited by insects, yet of a less consistent and more brittle character than the adjoining portions of the hawthorn's shoot. An interesting paper of Mr. Don of Hull—to which we are indebted for most of these particulars respecting the *Æcidium laceratum*, and which was published in the Memoirs of the Caledonian Horticultural Society, and republished in the 'Quarterly Journal of Agriculture' and 'Loudon's Gardener's Magazine'—states that, in 1812 and 1813, about 100 yards of a young hawthorn hedge round the botanic garden of Hull, were reduced by this fungus to a dwarfish condition, and that every one of the mildewed shoots appeared to have died down to the lowest protuberance.

The rapid, irrepressible, and devastating spread of the *Æcidia* is a phenomenon well worthy of investigation, and, as yet, very obscurely apprehended. The leaves of plants, it has been thought by some persons, are affected with some loss of energy, become suitable soil for the feeding of fungi, and speedily receive some of the innumerable spores which are supposed to be floating in the atmosphere. But both this hypothesis and most others which have been advanced, seem to be quite incompatible with the fact that the æcidia, as well as the genera allied to them, uniformly develop themselves beneath the epidermis or within the leaf-veins of plants; and burst out-

wards through the epidermis in order to attain maturity. Mr. Dovaston, writing in the *Magazine of Natural History*, and endeavouring to account for the appearance of fungi in those circles in grass lands popularly called fairy rings, starts the additional objection that spores never appear to germinate in a quiescent or unexcited state, and suggests a theory which other naturalists have adopted, and which appears to coincide perfectly with facts. He says, "We very rarely find them without some visible (and never perhaps without some latent) excitement, such as dung, combustion, decomposing woods or weeds; indeed, the seeds of fungi are so absolutely impalpable, that I have sometimes thought they are taken up with the juices into the capillary tubes of all vegetables, and so appear, when decomposition affords them a pabulum or excitement, on rotten wood and leaves; and this seed is produced in such quantities, thrown off so freely, and borne about so easily, that perhaps there is hardly a particle of matter whose surface is not imbued therewith; and had these seeds the power of germinating by mere wetness alone, without some exciting cause, all surface would be crowded with them, and pasturage impeded." The exciting cause which Mr. Dovaston assigns is electricity. See articles FUNGI and MILDEW.—*Loudon's Encyclopædia of Plants*.—*Sowerby's English Fungi*.—*Memoirs of the Caledonian Horticultural Society*.—*Loudon's Gardener's Magazine*, vols. iii., iv., vii., viii., and ix.—*Magazine of Natural History*.—*Quarterly Journal of Agriculture*.—*Loudon's Hortus Britannicus*.

ÆGILOPS,—popularly HARD GRASS. A genus of grasses of the tribe olyreæ. One species, the rough-spiked, is from the Levant; one, the Cretan, is from Candia; one, the cylindrical, is from Hungary; and two, the oval-spiked and the long-spiked, are from the south of Europe. The rough-spiked is perennial; and all the others are annual. The oval-spiked is abundant in Sicily; it is gathered into bunches and burnt; and its seeds are collected in a slightly roasted condition after the burning, and are used by the peasantry as an agreeable article of food.

ÆGIPYRUS, or GOAT'S WHEAT. A variety of buckwheat; so called because it is long-bearded like the goat.

ÆGIRUS. The black poplar. The name ægirus means to rise again, and was applied to the poplar in allusion to the exuberance of young shoots rising from its roots.

ÆGOCERAS. The herb trigonella or fenugreek. The name ægoceras signifies goat-horned, and alludes to the scythe-shaped, acute-pointed pods of the fenugreek.

ÆGYLOPS. A disease of the inward coat of the eye, to which goats are subject; also, the great wild oat-grass, and the acorns of the holm-oak, on account of their supposed resemblance to the eye of a goat.

ÆGYPTIACUM. A mixture of verdigris,

vinegar, and honey, sometimes used for the disease called foul in the foot of cattle, when no fungus or proud flesh is present to require the use of the butyr of antimony. It is composed of 5 oz. powdered verdigris, 1 lb. of honey, and 7 oz. of vinegar, boiled together to the consistence of honey.

AERATION. The intermixing of air with the soil. The presence and circulation of the air in the soil, in as many minute streams and as large aggregate quantities as possible, is important for bringing abundance of carbonic acid and of ammoniacal gas into contact with the spongioles of plants, for supplying oxygen to the requisite process of decomposing vegetable manures and other dead vegetable substances in the soil, and for carrying off disadvantageous gases formed by the excrementitious deposits of plants. Any degree of vegetation requires aeration of the soil as absolutely indispensable; and a free or luxuriant vegetation, all other conditions being equal, will be promoted in the exact degree in which aeration exists.

The grand means of effecting aeration are such as maintain porosity of the soil. Mere pulverization—designed to be effected by the most thorough processes of tillage, and so much and justly insisted on as a prime and essential feature of good farming—brings particles of soil into contact with all the radicles and spongioles of plants, so as to employ and stimulate them all in the work of taking up nourishment to the interior of plants; and though it often, at the same time, makes the soil thoroughly porous, and in consequence secures the processes of aeration, yet it occasionally makes no provision whatever for these processes, but rather tends to prevent them. Suppose a soil to consist of minutely comminuted particles, to be free from stones or gravel, to possess a considerable tendency to cohesion or consolidation—suppose it to be one of those clays, or fine loams, or greasy moulds which, when wetted and slightly rubbed, take a skin or surface almost as smooth as crockery—a reflecting farmer will see at a glance that, under certain conditions of weather, this soil may, by the very process of thorough pulverization, be in a short time rendered almost impenetrable by the air,—and that, in order to effect its aeration, the tilling of it must be accompanied with such a kind of manuring as, either by mechanical or by chemical action, will diminish its tendency to cohesion. The fine powdering of the soil, let it be understood, only occasions every part of a seed or root to be in contact with the materials of food; and the porosity or loose texture of the soil, during the whole period of a plant's growth, is requisite for the digestion of these materials by the supply of air. Hence, the utility of hoeings and other stirrings of the soil during the growth of plants,—and the necessity of proportioning the extent or number of these operations to the degree of stiffness or looseness naturally possessed by the soil.

Air is supplied, however, not only in a direct manner by the atmosphere, but indirectly and quite as necessarily and efficiently by water. The free circulation of water in the soil, by its ready descent as liquid and its ready ascent as vapour, is essential for the sake of the water's own agency upon plants,—so much so that the farmer must provide for both a free filtration at the surface, and a free drainage in the subsoil; but this circulation of water—at least downward—is not less important for the conveyance into the soil of oxygen, carbonic acid, and ammoniacal gas, the last contained in rain-water itself, and the first and second contained in the atmospheric air. All water which is exposed to the atmosphere contains a sufficient proportion of the atmospheric gases to be distinctly perceived by the human palate; and hence running waters, taken directly from fountain or river, have always an agreeable gout or flavour, while the same waters, when deprived of their atmospheric gases by boiling or distillation, are always disagreeable and vapid. Any running water, therefore, when permitted to circulate freely in the soil, carries along with it a certain amount of aeration. But rain-water is most eminently aerative; for it descends so far and in such small drops, and is so tossed by the wind or moving air, that it completely saturates itself with the atmospheric gases; and, as already hinted, it also brings down the ammoniacal vapours which escape from animal decompositions, and, by depositing these in the soil, supplies one of the most fertilizing and vital of manures. The plentiful collection or drinking up of air, and the carrying of this into the soil to operate upon the spongioles of plants, is a main reason why artificial waterings with a very fine rose are much more beneficial than waterings with a rose of comparatively larger orifices. See articles AIR, ATMOSPHERE, GERMINATION, and ELABORATION.

AERIAL ROOTS. Roots which issue from the upper stem, and descend through the air to the soil, either in virtue of the natural habits of a plant, or in consequence of its growing in extraordinary circumstances. The stem of the plant called *Pandanus odoratissimus*, is of comparatively small diameter at the base, but widens as it ascends; and as it is arborescent, and cannot readily admit the internal descent of root fibres originating in its wider part, it sends out these fibres from buds considerably above the surface of the ground, to descend through the air to the soil, and there to accomplish the double purpose of giving the plant stability, and of supplying it with nourishment.—In 1817, at Newabbey in Kirkcudbrightshire, a plane-tree, 20 feet in height, was growing on the top of a stone-wall, which measured 10 feet from the ground. "On this bare and scanty soil, it could not originally have found much nourishment, and could not send down its roots through stone and mortar. Accordingly it had been compelled, many years before, to protrude them into the open air. They

elongated by descent, clinging to the side of the wall, and throwing out neither bud nor branch till they reached the ground, which they did after a period of several years. Here, having plunged their extremities into the soil, they found and transmitted the necessary nourishment, and the tree grew with vigour." [Keith's Lexicon, on the authority of the Philosophical Magazine.] Aerial roots have, in some recent instances, been forced from some hothouse plants in the conducting of experiments for ascertaining how far vegetation may be maintained in independence of the soil; but they have been produced only by slow degrees, in successive stages, and in the course of a prolonged, cautious, and piecemeal process of detachment from the soil and suspension in the air. The only practical lesson of any consequence taught by these experiments, is the important one that all plants derive a large proportion of their nourishment from the air, that some may be trained to nourish themselves wholly from it, and that most employ the soil more for their mechanical fixture or for the preparation of their food, than for any purposes of proper nourishment.

AERIDES. See AIR-PLANTS.

AERIE. The nest of eagles, hawks, and other birds of prey.

AERIFORM BODIES. A term of frequent occurrence in chemistry and physics. Bodies exist in three states; as solids, liquids, or aeriform bodies; and these last are divided into vapours and gases. Vapours are characterized by the readiness with which they return to a liquid or a solid state, at or above ordinary temperature and pressure. Thus the vapour of mercury readily condenses into the liquid metal; and the vapour of camphor easily returns to its solid state. Gases, on the other hand, are always aeriform at common temperature; nor can they be rendered liquid or solid without a considerable increase of pressure, or reduction of temperature, or both conjoined. Some of them, indeed, have never yet been condensed. But the distinction between vapours and gases is not absolute, but one of convenience only: for in the only point of difference,—the relative forces which they oppose to condensation,—they graduate into each other. In common with liquids, they are also termed fluids; and aeriform bodies are elastic fluids without cohesive but probably with adhesive force; while liquids are inelastic fluids under the laws of cohesion.

AEROLITES. Meteoric stones. They are of various sizes, and fall sometimes singly, sometimes in showers. Most of them vary in size from the bulk of a pin's head to that of a pea; and few are more than three or four pounds in weight; but one which fell in Bahia, in Brazil, weighs about 14,000 pounds. Their fall is usually preceded or accompanied by meteoric lights and sounds. They bear a close resemblance to each other in both texture and mineral composition,

yet considerably differ from all known mineral substances in the crust of our world. They have a rough or granulated, unglossy, black-coloured surface; they have an interior texture, greyish in colour, and more or less granulated; and, judging from an analyzed specimen which fell in Yorkshire, they consist of 75 parts of silica in every 162, of 37 parts of magnesia, of 48 parts of oxide of iron, and of 2 parts of oxide of nickel. Their origin has been a problem among philosophers; and the place of it has been variously assigned to our own atmosphere, to the moon, and to some of the planets.

AEREOMETRIC BEADS. Instruments for ascertaining the comparative richness of any specimen of milk in the elements of butter and cheese. New milk, on account of containing the oily matter of butter, is lighter than skimmed milk; and skimmed milk, on account of containing the curdy matter of cheese, is heavier than whey. Now if any specimen of new milk, as soon as cooled, be tried by the aereometric beads, if the skimmed milk of it, immediately after the removal of the cream, be also tried, and if the whey, immediately after the extraction of the curds, be likewise tried, the difference of specific gravity which the beads indicate between the new milk and the skimmed will show the proportion of butter, and the difference of specific gravity which they indicate between the skimmed milk and the whey, will show the proportion of cheese. These beads were invented in 1816 by Mrs. Lovi of Edinburgh. See articles **LACTOMETER** and **MILK**.

ÆSCULUS,—popularly **HORSE CHESTNUT**. A genus of deciduous trees, forming the type of the order *Hippocastaneæ*. The common horse chestnut, *Æsculus hippocastanum*, was brought from the northern parts of Asia to Europe about the middle of the 16th century, and to England about the year 1683 or 1689; and, for sometime after its introduction, was in much greater favour than in recent times. It is a large and singularly handsome tree; it grows to the height of 70 or 80 feet; and, though sending out long and large branches, it forms a close thickset head of beautiful parabolic outline. Its leaves are large, palmated, and of a dark green colour; and they appear very early in spring, and possess surpassing beauty while in the process of unfolding from the body; but they unhappily begin to fall at a correspondingly early period, and make a litter below the trees from the month of July till the branches become quite bare. Its flowers are eminently handsome; they stand thick and prominent among the foliage, in the form of fine spikes; and, seen at even a brief distance, they appear almost to rival the oriental hyacinth. Young shoots start and grow with such rapidity and vigour, that instances of them have been observed 18 inches in length, and covered with leaves within three weeks of the period of the tree's exfoliation.

When the horse chestnut stands in isolated

positions, or when it forms rounded groups in lawns and parks, it is one of the most eminently ornamental trees grown in Britain, and, for beauty of form, foliage, and flower, during the season of its bloom, is absolutely without a rival; yet, in consequence of the litter made by its leaves throughout the autumn, it is an undesirable tree for avenues or for the immediate vicinity of roads. Its uses, as a timber tree, are scarcely superior to those of the most common brushwood. Its nuts or fruit, in this country, are greedily eaten by deer, and have been used for the fattening of swine; in Turkey they are ground to powder, and mixed with the provender of horses, especially of such as are broken-winded or troubled with coughs; and in Switzerland, they are crushed as food for sheep, and given in meals of 2 pounds to each sheep morning and evening, and are said to be in universal repute, not only for the fattening of the animals, but for producing excellently flavoured mutton.

The horse chestnut is propagated from the fruit. The best time for sowing is October; yet, in consequence of general inability to have ground then in readiness, the common time of sowing is early in spring. The nuts, when not sown in October, ought to be preserved in dry sand; and, as some of them are likely to lose their vitality, they ought to be put in water, and only those taken for use which are found to sink. They should be sown in drills, about two inches asunder; the seedlings may, next year, be transplanted to a nursery-bed; and the young trees, when large enough to be removed to their final destination, ought to be placed with care in a well-prepared site, and protected by a proper local fence from cattle. After the trees are fairly in their place, they should never be touched by knife or hatchet, but should be allowed, by thoroughly natural development, to form their fine parabolic heads, and assume their utmost beauty.

A number of other varieties or species of the horse chestnut than the common one are known to botanists and gardeners, and grown as ornamental plants. The chief of these are the golden-striped, *Æsculus hippocastanum foliis aureis*,—the silver-striped, *A. hippocastanum foliis argenteis*,—the double-flowered, *A. hippocastanum flore pleno*,—the flesh-coloured, *A. carnea*,—the rose-coloured, *A. rosea*,—the red-coloured, *A. rubicunda*,—the American, *A. Americana*,—the Ohio, *A. Ohioensis*,—the long-spiked, *A. macrostachya*,—the pale-coloured, *A. pallida*,—the yellow-coloured, *A. flava*,—the smooth-leaved, *A. glabra*,—the variegated-flowered, *A. hybrida*,—the dwarf, *A. discolor*,—the neglected, *A. neglecta*,—the lowly, *A. humilis*,—Lyon's, *A. Lyoni*,—and a kind called Whitley's fine scarlet. But about one-half of these belong to the recently constituted genus *Pavia*. Though the kinds named *carnea*, *rosea*, and *rubicunda*, are sold as different species, or at least as well-marked varieties, they are really identical with one another; and though

they are sold under the name of scarlet-flowered horse chestnuts, the only really scarlet-flowered variety at present known is that called Whitley's fine scarlet, and recently introduced from America. Two well-marked varieties of the yellow-flowered horse chestnut are known. The American horse chestnut is a very good sort, with red or pink flowers; the variegated-flowered, is a desirable kind; and the long-spiked flowers freely, and is a compact and erect grower.

A group of ornamental shrubs or small trees shares with the *æsculus* the more general botanic name of *Hippocastaneæ*, or plants of the horse chestnut family; and, though now made a separate group or genus of that family under the name of *Pavia*, they formerly shared even the generic name of *æsculus*, and were popularly called scarlet horse chestnuts. These shrubs grow to the height of about 16 or 18 feet; their growing shoots in summer are of a reddish hue; their leaves are palmated, and somewhat similar to those of the *æsculus*, but smaller; and their flowers bloom from April till about the middle of June, are of a bright red colour, and continue in succession during upwards of six weeks. The principal species or varieties of the *Pavia*—sometimes popularly called the Buck's Eye Tree—are seven in number, and designated *rubra*, *carnea*, *humilis*, *hybrida*, *flava*, *neglecta*, and *macrostachya*.—*Treatise on Planting in Library of Useful Knowledge*.—*Marshall on Planting*.—*Miller's Gardener's Dictionary*.—*Loudon's Gardener's Magazine*, vol. ii.—*The Gardener's Chronicle*, 1843.—*Loudon's Hortus Britannicus*.

AESTIVATION. The flowering or summer condition of plants; as vernal or leafing is their spring condition, ripening or fructification is their autumn condition, and sleeping or hybernation is their winter condition.

ÆTHIOP'S MINERAL. The black sulphuret of mercury. It is occasionally used as an alterative in cases of mangy affections in any of the animals of the farm, and in cases of surfeit or foulness of skin in the horse. The dose of it is three drachms daily for the horse; and an accompanying dose of four drachms of cream of tartar is advantageous.

AETHRIOSCOPE. A recently invented instrument for detecting and indicating pulsations or sudden streams of altered temperature in the atmosphere. Pulsations or dartings of heat upward from the earth to the higher regions of the atmosphere, and of cold downward from the higher regions of the atmosphere to the earth, are now believed to be a distinct phenomenon in meteorology, and to possess a very intimate connexion with changes of weather, and particularly with the fall of dews; and as they are undetected by our ordinary weather-glasses, and unindicated by all our other means of prognostication, an instrument which shall really detect and measure them, promises to be of considerable value to the farmer. The aethrioscope, however, has not yet been

sufficiently tried to establish confidence in its powers; and even if in principle a successful invention, it will probably admit of material improvement. The following somewhat florid account of it, taken from the article 'Climate' in the seventh edition of the *Encyclopædia Britannica*, rather speculates as to what an improved instrument may effect, than states what the present instrument has actually accomplished; and is introduced here less for the sake of what it says respecting the instrument itself, than for sake of the notice which it contains of the pulsations of the atmospheric temperature. "The aethrioscope opens new scenes to our view. It extends its sensations through indefinite space, and reveals the condition of the remotest atmosphere. Constructed with still greater delicacy, it may perhaps scent the distant winds, and detect the actual temperature of any quarter of the heavens. The impressions of cold which arrive from the north will probably be found stronger than those received from the south. But the facts discovered by the aethrioscope are nowise at variance with the theory of the gradation of heat from the equator to the pole, and from the level of the sea to the highest atmosphere. The internal motion of the air, by the agency of opposite currents, still tempers the disparity of the solar impressions; but this effect is likewise accelerated by the vibrations excited from the unequal distribution of heat, and darted through the atmospheric medium, with the celerity of sound. Any surface which sends a hot pulse in one direction, must evidently propel a cold pulse of the same intensity in an opposite direction. The existence of such pulsations, therefore, is in perfect unison with the balanced system of aerial currents. The most recondite principles of harmony are thus disclosed in the constitution of this nether world. In clear weather, the cold pulses then showered entire from the heavens will, even during the progress of the day, prevail over the influence of the reflex light, received on the ground, in places which are screened from the direct action of the sun. Hence at all times the coolness of a northern exposure. Hence, likewise, the freshness which tempers the night in the sultriest climates, under the expanse of an almost azure sky. The coldness of particular situations has very generally been attributed to the influence of piercing winds which blow over elevated tracts of land. This explication, however, is not well founded. It is the altitude of the place itself above the level of the sea, and not that of the general surface of the country, which will mould its temperature. A cold wind, as it descends from the high grounds into the valleys, has its capacity for heat diminished, and consequently becomes apparently warmer. The prevalence of northerly above southerly winds may, however, have some slight influence in depressing the temperature of any climate. In our northern latitudes, a canopy of clouds generally

screens the ground from the impressions of cold. But within the arctic circle, the surface of the earth is more effectually protected by the perpetual fogs which deform those dreary regions, and yet admit the light of day, while they absorb the frigorific pulses vibrated from the higher atmosphere. Even the ancients had remarked that our clear nights are generally likewise cold. During the absence of the sun, the celestial impressions continue to accumulate; and the ground becomes chilled to the utmost in the morning, at the very moment when that luminary again resumes its powerful sway. But neither cold nor heat has the same effect on a green sward as on a ploughed field, the action being nearly dissipated before it reaches the ground among the multiplied surfaces of the blades of grass. The lowest stratum of air, being chilled by contact with the exposed surface, deposits its moisture, which is either absorbed into the earth, or attracted to the projecting fibres of the plants, on which it settles in the form of dew or hoar-frost. Hence the utility, in this country, of spreading awnings at night, to screen the tender blossoms and the delicate fruits from the influence of a gelid sky; and hence, likewise, the advantage of covering walled trees with netting, of which the meshes not only detain the frigorific pulses, but intercept the minute icicles, that, in their formation, rob the air of its cold." See articles ATMOSPHERE, DEW, TEMPERATURE, CLIMATE, and WEATHER.

AFFINITY. That variety of attraction which is exerted between different kinds of matter, at insensible distances, uniting them into a new body, possessed of properties essentially different from those of its constituents. By acting only at insensible distances, it is sufficiently distinguished from gravity; exerted only between different kinds of matter, it is very different from cohesion; but it is more difficult to draw a narrow line of demarcation between affinity and that form of attraction which is usually placed under *heterogeneous adhesion*, viz., the attraction evinced in solution, for the latter seems to form a connecting link between chemical and other kinds of attraction. The latter part of the above definition, that "it forms bodies essentially different," will serve to distinguish it from attraction in solution.

Affinity is not always exerted between bodies; thus fluorine does not combine with oxygen, but readily with metals. Carbon does not unite with mercury, but combines with oxygen, iron, &c. It is therefore elective in its character, preferring one body to another. Such a view, however, is only in accordance with the present state of the science, for it is possible that each element may combine with each of the others; but that other forces interfere with the exercise of affinity. Thus nitrogen may have a strong attraction for the metals, and the reason why such compounds are difficult to make and easily

decomposed, may be the highly elastic state of nitrogen.

As far as we know, it acts at insensible distances, but it is possible that the distance to which its energy extends may be measured. Thus the union of some bodies by friction, when in a minute state of mechanical division, seems to hint at a sensible distance of action.

Affinity must be sufficiently powerful to overcome the opposing forces of gravity, cohesion, and elasticity. The bodies must be in immediate contact, since the action is at insensible distances. It is rarely sufficient to pulverize two solids, however fine, to induce their chemical union, for their particles do not admit freely of motion, but by constant and rapid trituration many points of surface are brought in contact nearly at one time, and combination may ensue; in this manner sulphur and finely divided copper unite with the evolution of heat. The affinity of bodies is, therefore, promoted by everything which tends to their close approximation; in solids, by their pulverization and intermixture, this attraction residing in the ultimate particles of bodies; in gases, by their spontaneous diffusion through each other, which occasions a more complete intermixture than is attainable by mechanical means; and between liquids, or between a liquid and solid by the adhesive attraction which liquids possess, which must lead to perfect contact, and also by a disposition of liquid bodies to intermix, of the same physical character as gaseous diffusion. Elevation of temperature has certainly often a specific action in increasing the affinity of two bodies; but it also often acts by producing a perfect contact between them, from the diffusion or vaporization of one or both bodies. Hence, no practice is more general to promote the combination of bodies than to heat them together. Thus fused sulphur does not unite with carbon, but must be brought in the vaporous state, in contact with carbon: effloresced carbonate of soda absorbs carbonic acid at first, slowly; but more rapidly in proportion as absorption develops heat, until at length its absorption is violent. Carbon, iron, &c., must be heated in oxygen to develop their affinity for it.

Light may frequently induce union like heat; thus chlorine with hydrogen or carbonic oxide. Electricity may also unite gases by heat or compression, as hydrogen and oxygen, &c. The expansion of a gas often assists affinity; thus phosphorus exhibits slow combustion in oxygen at a lower temperature, the more the gas is expanded. Condensation frequently effects union by the heat it develops, and by bringing the particles in closer contact.

If the affinity between two gases is sufficiently great to begin combination, the process is never interrupted, but is continued from the diffusion of the gases through each other till complete, or at least till one of the gases is entirely consumed. Thus when hydrochloric acid and ammoniacal

gases, in equal measures, are introduced into a jar containing at the same time a large quantity of air, the formation of hydrochlorate of ammonia proceeds, the gases appearing to search out each other, till no portion of uncombined gas remains. The combination of two liquids, or of a liquid and a solid, is also facilitated in the same manner by the mobility of the fluid, and proceeds without interruption, unless, perhaps, the product of the combination be solid, and by its formation interpose an obstacle to the contact of the combining bodies. But the affinities of two solids which are not volatile, are rarely developed at all, owing to the imperfection of contact. Even the action of very powerful affinities between a solid and a liquid or a gas, is often arrested in the outset from the physical condition of the former. Thus the affinity between oxygen and lead is certainly considerable, for the metal is rapidly converted into a white oxide, when ground to powder and agitated with water in its usual aerated condition; and in the state of extreme division in which lead is obtained by calcining its tartrate in a glass tube, the metal is a pyrophorus, and combines with oxygen when cold, with so much avidity as to take fire and burn the moment it is exposed to the air. Iron also, in the spongy and divided state in which it is procured by reducing the peroxide by means of hydrogen gas at a low red heat, or by treating the oxalate in a tube, absorbs oxygen with equal avidity at the temperature of the air, and takes fire and burns. But notwithstanding an affinity for oxygen of such intensity, these metals in mass oxidate very slowly in air, particularly lead, which is quickly tarnished indeed, but the thin coating of oxide formed does not penetrate to a sensible depth in the course of several years. The suspension of the oxidation may be partly due to the comparatively small surface which a compact body exposes to air, and which becomes covered by a coat of oxide, and protected from farther change; but partly also to the effect of the conducting power of a considerable mass of metal in preventing the elevation of temperature consequent upon the oxidation of its surface; for metals oxidate with increased facility at a high temperature, such as the lead pyrophorus quickly attains from the oxidation of the great surface which it exposes, compared with its weight. The heat from the oxidation of the superficial particles of the compact metal, however, is not accumulated, but carried off and dissipated by the conducting power of the contiguous particles, so that elevation of temperature is effectually repressed. It thus appears that the state of aggregation of a solid may oppose an insuperable bar to the action of a very powerful affinity.

The affinity of two bodies, one or both of which are in the state of gas, is often promoted in an extraordinary manner by the contact of certain solid bodies. Thus oxygen and hydrogen gases may be mixed and retained for any length of

time in that state without exhibiting any affinity for each other, and the gaseous mixture may, indeed, be heated in a glass vessel to any temperature short of redness, without showing any disposition to combine. But if a clean plate of platinum be introduced into the cold mixture, the gases in contact with the metallic surface instantly unite and form water; other portions of the mixture come then in contact with the platinum and combine successively under its influence, so that a large quantity of the gaseous mixture may be quickly united.

Chemical combination of two bodies seems often to take place only by the co-affinity of other bodies with each other. Thus nitrogen and hydrogen gases do not form ammonia by direct union, but by the oxidation of tin by nitric acid or by nitric oxide and water; the metal abstracts oxygen both from the water and nitrous body, evolving nitrogen from the latter and hydrogen from the water, which, in their then nascent state, combine to form ammonia. Such combinations of bodies in their nascent state are very numerous, and we are unable to produce a large number of them in any other way; such, for example, are numberless artificial compounds, developed in the province of organic chemistry.

There is another singular operation of affinity allied to the preceding, which is not well understood. It may be termed *inducing*, *inductive*, or *imparted affinity*. Attention was drawn to it by Liebig, in a general way, who classified some of the facts by the law, that a body while in the act of combining has the power of imparting the same action to another body in contact with it, inducing it to unite with a third body, when it would not have done so under similar circumstances, without such contact. Nitrogen and oxygen do not unite by heat, and indeed difficultly in any way; but hydrogen burned in the air produces water containing nitric acid; platinum is wholly insoluble in and not oxidized by nitric acid when alone, but it is so when alloyed with silver. This interesting subject is deserving of a full and extended investigation, which would unquestionably lead to a much more thorough knowledge of the operations of affinity than we at present possess.—*Booth's and Boye's Encyclopedia of Chemistry*.

AFRICAN ALMOND,—botanically *Brabejum*. A tender evergreen tree of the Protea family. It attains a height of fifteen feet; and its racemes of splendid flowers have been compared in their appearance to a sceptre.

AFRICAN LILY,—botanically *Agapanthus*. A genus of flowering bulbous-rooted plants of the hemerocallis or day-lily family. They are much esteemed by gardeners, and carry handsome blue flowers. The number of species is only three.

AFRICAN MARIGOLD,—botanically *Tagetes erecta*. A well-known and favourite annual flowering plant of the composite tribe. It is a native of Mexico, but has long been naturalized

and generally diffused in the gardens of Great Britain. Its popular epithet 'African' is an absurd misnomer. Five varieties of the plant were cultivated in the days of Miller,—the pale yellow, the deep yellow, the orange-coloured, the middling, and the sweet-scented. Unless the seeds are carefully gathered from the finest flowers, all the varieties are very apt to degenerate. The plant flowers from July till the season of frost.

AFTERBIRTH. The membranaceous or solid discharge which follows the expulsion of a foetus. It is technically called *placenta*, from its similarity of form to a cake. See articles **ABORTION** and **PARTURITION**.

AFTERGRASS. The second crop of grass in a season, or that which grows after mowing. The word is often applied to the second crop of grass under any conditions, and sometimes even to the grass which is cut after some kinds of corn crops; but it is better understood when restricted to the second crop of meadow lands, or to that which follows a first and mown grass crop. The late Mr. G. Sinclair, who conducted a course of elaborate experiments to ascertain the comparative nutritiousness of the various grasses to one another, and of the same grasses under different conditions, found that a certain quantity of perennial ryegrass, when taken in flower from a water meadow which had been fed off with sheep till the end of April, contained 72 grains of nutritious matter,—that the same quantity taken from a portion of the same meadow which had not been fed off, contained 100 grains,—that the same quantity taken from a rich old depastured field which had been shut up from stock at the end of April, in order to its yielding a crop of hay, contained 95 grains,—and that the same quantity taken from a portion of the same field which had not been recently depastured, contained 120 grains. This analysis not only is of great general interest, for evincing how very widely the intrinsic value of a grass varies under different conditions of growth; but also possesses special interest on the subject of aftergrass, as showing that the plants of which it consists are likely to be much affected in their worth by the treatment which the field receives both before the growth of the spring crop and after it is cut down. Mr. Sinclair analyzed 64 drachms weight of each of several kinds of grasses in the spring crop, and in the aftergrass of meadows, and found the following results:—Sweet-scented vernal grass contained 1 drachm 3 grains of nutritious matter in the spring crop, and 2 drachms 1 grain in the aftergrass; sweet-scented soft grass contained 4 drachms 1 grain in each of the crops; smooth-stalked meadow-grass contained 1 drachm 3 grains in each of the crops; short blue meadow-grass contained 2 drachms in each of the crops; cow grass contained 2 drachms 1 grain in each of the crops; creeping fescue-grass contained 1 drachm 2 grains in each of the crops; round paniced cock's-foot

grass contained 2 drachms 1 grain in the spring crop, and 1 drachm 2 grains in the aftergrass; meadow fox-tail grass contained 3 drachms 1 grain in the spring crop, and 2 drachms in the aftergrass; larger-leaved creeping bent-crested dog's-tail grass contained 4 drachms 1 grain in the spring crop, and 2 drachms 2 grains in the aftergrass; hard fescue-grass contained 3 drachms 2 grains in the spring crop, and 1 drachm 1 grain in the aftergrass; Welsh fescue-grass contained 2 drachms 1 grain in the spring crop, and 1 drachm 1 grain in the aftergrass; and yellow oat grass contained 3 drachms 3 grains in the spring crop, and 1 drachm 1 grain in the aftergrass. Thus only one of the grasses, and that a mere condiment, was found of greater value in the aftergrass than in the spring crop; five, and these of only second or third rate importance, were found of equal value in the two crops; and six, of aggregately more important character than the others, were found to be of very much greater value in the spring crop than in the aftergrass. Yet the case of perennial ryegrass already stated,—on account of its being the case of by far the bulkiest of the artificial grasses usually grown, and on account also of the very marked variations which it exhibits in the value of the plant under different conditions of growth,—is much the most important of them all, and strongly proves the necessity of making the principles and calculations of an enlightened economy to bear upon the general treatment of grass lands.

The aftergrass of meadows of all kinds, when not designed to be cut down for hay or rowen, ought, in every well-regulated system of husbandry, except in extraordinary circumstances, to be fed off during autumn and the earlier parts of winter. If the lands be firm, and the season dry, the grass may be consumed by any class of stock; but some meadows cannot without damage be depastured at any time by horse or black cattle, and most meadow lands are unsuited for them, or for any stock but sheep during winter. The bite of horses is so close as often, in soft ground, to tear up the herbage, to the damage or destruction of its roots; and the tread of black cattle, on clayey or moist grounds, makes holes which destroy the herbage for years, and which hold stagnant water to the utter damage of the surrounding plants. An excellent practice, in most circumstances, is to depasture aftergrass with heavy stock during the dry part of the year, and to restrict it to sheep during winter. In Middlesex, black cattle are usually removed from meadow lands in November; horses, in December; and sheep, not till February. But in Leicestershire, in Lincolnshire, and in many other districts, stock of all kinds are allowed to remain on meadow lands, not only during winter, but till May, and sheep even till April. Much, it is obvious, must depend on the special character of the lands for firmness and fertility; something also on the particular character of the season,

particularly the comparative dryness of the winter; and a good deal likewise on the other resources of the farm for the supply of food to stock. Yet a good farmer will be chary about damaging the young grass by too advanced pasturing in spring; he will take care to prevent the grass-roots of his meadow from destruction by tearing and deep treading; and for these reasons, as well as for others—if not urged by some unusual concurrence of circumstances—he will have all his aftergrass fed off clean against the first or second stage of winter, and will possess a sufficient store of hay, straw, mangel-wurzel, carrots, turnips, and other storeable provender for the entire feeding of his stock during the middle and last stages of winter, and for their partial feeding from the beginning of spring till the month of May.

A peculiar treatment of meadows, called fogging, was ascertained to prevail in the latter half of the last century in South Wales, and was introduced to English husbandry, and recommended, by the well-known Arthur Young. This treatment—to speak paradoxically—converted the whole yearly produce of the meadows into aftergrass; for it consisted in shutting up the meadows from all stock early in May, and keeping them completely untouched by scythe or beast till November or December, and then making them the feeding-ground of the whole stock of the farm till next May. “Many years ago,” says Mr. Young, “I knew a Suffolk clergyman who was in the regular habit of this singular practice, and spoke of it as a most profitable one. I have tried it thrice, and with success; it thickens herbage greatly, and yields far more valuable winter and spring food than any person would expect who never tried it.” This method, however, as may be seen at a glance, can be profitable or even practicable only on very dry firm land; and hence, it existed in South Wales only upon upland pastures, and was tested by Mr. Young upon the sandy and semi-arid grounds of Norfolk.

Another practice is, after cutting down and removing the hay crop of meadows, to keep the aftergrass untouched by either beast or scythe throughout the autumn and the winter, and to employ it for the spring feeding of sheep. This practice, we believe, is unknown in Scotland or the north of England, and seems to us at once wasteful, slovenly, and not over healthy; yet it has been recommended by such eminent men as Young and Marshall and Dr. Wilkinson, and is asserted by many to provide the cheapest spring food for sheep in general, and a better food than turnips, cabbages, or any other kind whatever for ewes and lambs. Dr. Wilkinson says, “This food with him (the aftergrass kept intact till spring) afforded a more nutritive and healthful quality of milk from the ewes to their tender lambs than turnips even in their best state.” Mr. Marshall says that, as a certain and wholesome provision for ewes and lambs in early spring,

the preserved aftergrass may be depended on as “the sheet-anchor, in preference to turnips, cabbages, or any other species whatever of what is termed spring-food.” And Mr. Young says, “If a field of this kept aftergrass be seen at any distance, it appears most unpromising, being of the colour of very bad hay; but enter it, and turn aside this covering with your hands, and the young green growth is found five or six inches high, nursed up by the shelter and warmth of the autumnal growth. I have often shown this to persons on my own farm, to their great surprise. The sheep eat both together; and it is found to agree with them remarkably, being, as it were, hay and grass in the same mouthful. I do not conceive that it is possible to keep a full stock of sheep so cheaply in April by any other method as by this.” Our objections to the practice—subject however to such slight modifications from peculiar circumstances as probably account for the recommendations of these eminent agriculturists—are that the grasses matured in autumn are, in a great measure, wasted,—that the remains of these grasses, in the form of what Mr. Young most inappropriately terms “hay,” are half-rotted by the moistures of winter, and cannot be wholesome food,—that some of the spring grasses are prematurely bitten down, and probably damaged,—and that the whole of the lands are liable to a choking moisture about the roots of their plants, and will be found more or less overrun by slugs and insects. Some allowance, and possibly an ample one, must be made for the dry climate, the arenaceous soils, and the peculiar grasses which have been concerned in the successful instances of kept aftergrass; but on the usually moist winter-grounds of Scotland and the north of England, and with the ordinary mixtures of pasture-grasses, whether spontaneous or sown, we should expect every farmer who might try this practice to find it at once dear, dirty, and unwholesome. A little confusion exists as to the proper name for kept aftergrass, Mr. Young calling it rowen and the Rev. Mr. Rham calling it fog,—while the former name is more commonly applied to the cut autumn crop, and the latter to the kept growing grass of the whole year for the spring feeding of the entire stock of the farm.

In the northern districts of England, the aftergrass is frequently kept untouched till November or even a later period, and is then used for the fattening of stock for the shambles, or for the pasturage of cows in order to the manufacture of cheese of superior quality. But this practice, as already hinted, occasions, in almost every instance, an extensive destruction of the grass-plants of meadows; and it also causes the neglect or loss of the lower growth of the grasses which cannot be bitten by cows, but might be fully available for sheep. The name *eddish* is applied to the aftergrass treated according to this practice; and—as another instance of the looseness of agricultural nomenclature—the same name is

applied to the grass which grows among the stubble of cut corn.

We have hitherto viewed the aftergrass as eaten off, or constituting pasture; but we must now glance at it as cut down, and constituting hay or rowen. In the former light, it is properly aftergrass; and in the latter, it becomes technically aftermath or lattermath. When meadow lands are rich, or when meadow hay is valuable, the treatment of the aftergrass as a crop for mowing, will usually be found profitable. Yet no general rule can be given to show, in every case, whether the depasturing or the mowing be the preferable course. When abundance of manure can be procured, or stimulating irrigation can be practised, or lamb-sucking is prevalent, or the market-price of hay is high, most farmers will probably judge it wise to cut a second crop of hay, and to assign only the aftergrass of that second crop to the depasturing of stock. Yet in the neighbourhood of London, where manure is very abundant, this practice is regarded as uneconomical and ultimately mischievous. When, on the other hand, a meadow is unusually low, wet, and retentive of water, it ought to be entered as seldom as possible by stock, and will yield better aggregate returns from second mowings than if it were trodden and ruptured by a full course of eating off. In most or all other circumstances, a meadow, if made to yield two crops of hay in the year, is certain to suffer more or less exhaustion, and, by wanting a requisite degree of pounding and abrasure from the feet of sheep or cattle, would probably become more or less infested with the vegetation of moss plants. As regards a field of sown grasses, however, the desire and effort of almost every farmer are, by all means, to obtain if possible a good second crop of hay.

The cutting of the second crop of grass requires more skill and attention on the part of the mower, than the cutting of the first. The grass of the second crop is, in general, much lighter and shorter than the grass of the first; and the scythe, except when in the hand of an expert workman, is apt to slice it, slip through it, or even rise over it. "Crops of this sort," remarks Mr. Loudon, "should always be cut as much as possible when the dew is upon them, and as soon as ever there is a tolerable growth; as, by waiting, the season is constantly getting more unfavourable for making them into hay; and when not well made, this hay is of little or no value." Another important matter is to have the surface of the meadow in a firm condition, and with levels or slopes or inclined planes as smooth if possible as a bowling-green; for if the surface be otherwise—especially if it abound in roughnesses and tiny undulations, the scythe will cut down only the body of the longest grasses and the tops of some of the shorter ones, and will leave an amount of understubble of tall plants and thick matting of dwarf plants, probably

quite as great as the portion of herbage it removes. If a complete depasturing with sheep is to follow the mowing, the smoothness of the surface is of less consequence; but if only a partial depasturing or no depasturing whatever is to follow, the annual loss occasioned by the roughness of a meadow's surface may be very serious.

The hay of the aftermath—technically called *rowen*—is inferior in value to that of the spring crop. The main reason of this is its great comparative deficiency in nutritious properties, as shown by the analysis of Mr. Sinclair which we noticed at the outset; and another reason is that it wants the seed-stalks of the plants, and in consequence is defective in some chief ingredients of the chemical composition of good fodder. This hay is not suitable for horses, especially for such as work hard, or are driven fast, or evince any tendency toward feebleness in the lungs; yet it is quite good for sheep and black cattle, and particularly for ewes and milk cows. Rowen, when well saved, is even a very profitable fodder for cows giving milk; for, in consequence of its being of a soft and succulent nature, and not so heating as other sorts of hay, it is well fitted to produce a large flow of milk. A consideration closely akin to this, is one reason why dairy farmers cut the grass of their meadow lands so many times during summer; though two other reasons are the procuring of the fodder in a very tender and succulent condition, and another is the stimulating of the grass plants to extend and multiply their herbage. Rowen is suitable and beneficial for feeding such ewes as are suckling house-lambs during winter, because in their case, as in the cow's, it produces a comparatively large flow of milk; and it is well adapted, also, for the feeding of such sheep as require the aid of hay during winter, and for the support of calves and of all sorts of young cattle which are kept as store stock.

The failure of the second crop of clover in any of the prevalent rotations in approved mixed husbandry, is now unhappily an event of frequent occurrence, and produces all the effects, in farm economy, of the failure of aftermath, and in fact is often spoken of under that designation. A frequent device hitherto for compensating for the failure, or obtaining a substitute for the provender a-wanting, is to grow tares. But this crop has the serious double disadvantage of greatly exhausting the soil, and of not affording in its green state sufficient nourishment for hard-working animals. A much more suitable substitute is a combination of such grasses as will mature their culms or flower-stems in the same season in which they are sown, and arrive successively at height and ripeness so as to afford a succession of forage, and, at the same time, admit of being treated as the basis of a grass-course or several years in continuance, or of what is technically designated permanent pasture. A combination of exactly this character is recommended

by Mr. Bishop of Methven Castle, in a paper which was published among the Highland Society's Prize Essays in 1839, and is stated to have been put to the test of experiments the results of which excited the attention and the high gratification of several gentlemen in the vicinity. Mr. Bishop's first combination of seeds consisted of 4 bushels of Italian ryegrass, *Lolium Italicum*,—8 lb. of broad-leaved Timothy-grass, *Phleum pratense*,—4½ pecks of fescue grasses, including 2½ pecks of meadow fescue, *Festuca pratensis*,—20 lb. of crimson clover seed, *Trifolium incarnatum*,—8 lb. red clover, *Trifolium pratense*,—and, to secure permanent pasturage, 12 lb. of white clover, *Trifolium repens*,—the whole sown on the 4th of May, on about 2½ imperial acres of land; and so astonishingly did it grow that it yielded a mowing for the food of horses on the 15th of August,—it was afterwards partly cut a second time,—and it continued to yield an abundant supply till the end of October. "The weight of green produce cut in a dry state on the 26th of September, yielded at the rate of 10 tons 7 cwt. per imperial acre, and in hay 2 tons 3 cwt." Mr. Bishop's combination, in the second year of his experiment, had also distinguished success; and it differed from the first, by increasing the red clover to 7 lb., lessening the crimson clover to 7 lb., adding 4 lb. per acre to the Timothy grass, adding ½ lb. per acre of meadow foxtail grass, *Alopecurus pratensis*, and, to secure a better form of permanent pasture, adding some of the poa and fescua genera to the white clover. See articles HAY, GRASS-LANDS, MEADOW, SHEEP, and CATTLE.—A. Young's *Farmer's Kalendar*.—Hunter's *Georgical Essays*.—Sinclair's *Hortus Gramineus Woburnensis*.—Low's *Practical Agriculture*.—Loudon's *Encyclopædia of Agriculture*.—Rham's *Dictionary of the Farm*.—Sinclair's *Code of Agriculture*.—Sproule's *Treatise on Agriculture*.—*Prize Essays and Transactions of the Highland Society*.

AFTERMATH. See AFTERGRASS.

AGAMOUS PLANTS. That class of plants in which, it is supposed, that no process of fecundation takes place, or in which there are no floral organs, or only such as have hitherto eluded the research of the naturalist. See ACOTYLEDONOUS PLANTS.

AGAPANTHUS. See AFRICAN LILY.

AGARIC. A white fungus, used in medicine and by dyers. The kind used in medicine is commercially called female agaric, and grows on larches; and the kind used by dyers is called male agaric, and grows on oaks. It was formerly used as a styptic, but is now chiefly used for preparing *amadou* or German tinder.

AGARICUS. The portion of the great family of fungi, which is represented by the cultivated and edible mushroom. See MUSHROOM. The species of Agarici indigenous to Great Britain are exceedingly numerous; and, except in a few instances, all are decidedly poisonous. A discovery

was made, about five years ago, that two or three of the species form by deliquescence an inky fluid, which dries into a bister-coloured mass, is capable of being used as a water-colour for drawings, and retains its colour in defiance of all the common chemical agencies. Dr. Coxe of America, who put the discovery completely to the test, is disposed to think that the deliquescent fungi might be prepared into an excellent India ink; that its dried deposit mixed with oil, might probably answer for engravings; and that, as the ink appears to be indestructible by any agency short of burning, it might be tried for the filling up of bank notes and other valuable papers. The kinds of Agarici which possess the inky property appear to be those designated *ovatus*, *cylindricus*, and *porcellaneus*. A property somewhat akin to that of these inky species exists, in a small degree, in most mushrooms, and affords a ready means of separating the large numbers of them which are poisonous, from the few which are edible. If a silver spoon, a silver coin, or an onion, be dipped into a vessel of seething mushrooms, it will be stained into a darkish colour when the mushrooms are poisonous, and quite unstained when the mushrooms are wholesome. Whenever a fungus is pleasant in flavour and odour, it may be considered wholesome; if, on the contrary, it have an offensive smell, a bitter, astringent, or styptic taste, or even if it leave an unpleasant flavour in the mouth, it should not be considered fit for food. The colour, figure, and texture of these vegetables do not afford any characters on which we can safely rely; yet it may be remarked, that in colour, the pure yellow, gold colour, bluish pale, dark or lustre brown, wine red, or the violet, belong to many that are esculent; whilst the pale or sulphur yellow, bright or blood red, and the greenish, belong to few but the poisonous. The safe kinds have most frequently a compact, brittle texture; the flesh is white; they grow more readily in open places, such as dry pastures and waste lands, than in places humid or shaded by wood. In general, those should be suspected which grow in caverns and subterraneous passages, on animal matter undergoing putrefaction, as well as those whose flesh is soft or watery.

AGAVE. See AMERICAN ALOE.

AGE OF ANIMALS. Either the average total lifetime of any species of animals, or the successive or precise period of lifetime of any individual of a species. In general, the term of life among the mammalia is in direct proportion to the time which they severally take in arriving at their full growth, exclusive of the period of gestation. Buffon calculated, from many observations, that they lived seven times the period of growth; but it is very often only six times this period. Among the most remarkable exceptions to the above rule, we find man, with whom the average duration of life is far less than that of other species, relative to his time of growth. As he does not attain his

full size until about the age of twenty years, his life ought to average a duration of 120 to 140 years. Several individuals have attained these ages, and some have even passed them; but of those few who survive the first years of infancy, by far the greater number do not pass beyond the ages of seventy or eighty. This anomaly to the rule of Buffon is due to a multitude of circumstances, such as the mode of life, the abundance and excess of food, the want of temperance, and other results of an imperfect and misdirected civilization. For the same reason, the relation which the period of growth bears to the whole term of life, is not without many exceptions among the domestic animals. On the one hand, they receive the influence of a superabundant nourishment, and, on the other, are more frequently preserved from those excesses to which this abundance might have given rise. Hence, the duration of life is often prolonged among the domestic animals beyond the term already specified. The growth of the horse being commonly completed in about four or five years, it lives twenty-five or even thirty-five, provided the natural term of its existence has not been shortened, as happens too frequently, by ill treatment of every kind, by violent fatigues, as well as the want of attention and suitable nourishment. This animal presents, notwithstanding, several instances of remarkable longevity, and some individuals have been known to attain the advanced ages of sixty and even seventy years. As the ass takes nearly as long as the horse in reaching its full growth, the duration of its life ought to be nearly the same; yet it often breaks down before that period through injuries or neglect, which it receives most undeservedly from all quarters. It is observed that animals, naturally disposed to chastity, live longer than those of different propensities. The mule and bardeau are usually unable to procreate, and accordingly they live longer than either the horse or ass. Very frequently mules die at the age of forty, and one has been known to attain the age of eighty years. The bull takes about two or three years in growing, and the natural period of its life terminates at fifteen to twenty years. The buffalo approaches the former very nearly in both of these respects; yet it appears to take a little longer time in reaching its full growth, and hence lives to a more advanced age. The sheep has nearly the same period of growth, and also a corresponding period of life. The goat approaches to the same terms, both in respect to its growth and the duration of its existence; yet the extreme attachment of these two last-mentioned species to sexual propensities serves to abridge the ordinary period of their lives, in those few cases where man does not terminate their existence suddenly for his own advantage. The hog being two years in attaining its full development, may reach the age of fifteen or twenty years, if not fattened before the term of puberty, as is most commonly done, though some old boars have

been known to pass far beyond the above-mentioned terms. We may thus perceive that the relation of the period of growth to the duration of life does not remain constant among the domestic animals. It is, however, more precise with the wild mammalia. The lion lives twenty-five years, according to Buffon, though several lions of the Tower-menagerie of London lived in confinement to the extraordinary ages of sixty-three and seventy years, on the authority of Shaw. The mococo (*Lemur catta*) lives at least twenty years, the rabbit eight or nine; the hare seven; the mouse only a short time. The elephant, it is said, lives for two hundred years; the bear thirty; and the wolf fifteen or twenty. Further, the dog usually lives fourteen years, though the lives of some individuals have been prolonged to twenty; the cat lives nine or ten years, and the dromedary forty or fifty. Nothing positive is known regarding the ages to which the seals and the cetacea respectively attain; it is, however, probable, from their near approximation to the fishes, in external characters, that they resemble them also in the average duration of life; in other words, they live to a very advanced age. This presumption is further confirmed with the seals, by the fact that they take a very long time in growing. But such facts as these are of a thousandfold less interest to the farmer than the indications or criteria of particular age in individual horses, cattle, and sheep.

Age of the Horse.—The chief criteria of a horse's age are certain successive and distinctive appearances of the teeth. The full set of teeth, or that possessed by the horse during the period of its vigour, amounts in number to forty, and consists of *nippers*, *grinders*, and *tushes*. The *nippers* are twelve in number, six above and six below; they are situated in front, and correspond to the incisors or front teeth of man; and they have their name from the peculiar action with which the horse twitches or nips off the successive portions of grass on which he browses. A polished and exceedingly hard substance, called enamel, covers all the parts of the nippers situated outside of the gum; and as this is gradually worn away by the action of the teeth in gathering food and nipping the grass, a portion of it passes over the upper surface of the teeth, bends inward, sinks into the bone, and forms a little pit; and the blackening of the inside and bottom of this little pit by the food constitutes what is technically called the mark of age,—a mark, which is at first broadly distinct, but which gradually diminishes in consequence of the wearing down of the edge, and which therefore forms, during several years, an unerring criterion of the animal's age. The *tushes* are four in number, two above and two below, at the sides of the nippers, separating them from the grinders; they are situated closer to the nippers than to the grinders, and closer to the nippers of the lower jaw than to the nippers of the upper; and they increase their distance from the



[illegible]



grinders in both jaws, as the age of the animal advances. They have some resemblance in form to a cone; they protrude about an inch from the gum, and have a curved and sharp-pointed extremity; they belong far less to the mare than to the male horse, being only stumps or germs in the former at five years of age, though fully developed in the latter; and they perform no apparent office in mastication, but seem to have served, in the wild condition of the horse, as his principal weapons of offence. The *grinders*—also called molars, jaw-teeth, or back teeth—are twenty-four in number, twelve above and twelve below; they are strong double teeth, with sharp edges, but gradually lose their sharpness and become smooth as the animal advances in age; and they have great strength and endurance, and are employed in grinding down the hardest portions of the horse's food. Enamel, similar to that of the nippers, completely covers the tops and sides of the grinders; but this is gradually worn from the tops by the mutual attrition of teeth and food; and what remains is a compound surface of alternate layers of crusted petraser, enamel, and ivory. Each grinder of the upper jaw consisted in embryo of five bony substances or teethlets agglutinated by a powerful cement into one compound tooth; and each grinder of the lower jaw consisted in embryo of four teethlets, and is smaller, narrower, and more regular than an upper grinder; and both, in consequence of their complex formation and mutual adjustment, possess a power of trituration, a strength of resistance, and an adaptation to the peculiar wants and constitution of the horse, which, in common with all the innumerable intricacies of animal organism, strikingly indicate the wisdom of the Creator. Neither the upper nor the lower grinders are placed horizontally; but the upper have their higher side without, and shelve inward; the lower have their higher side within, and shelve outward,—and thus they achieve the grinding motion with a facility of action and a maximum of power, which indicate the beneficence and skill of the Almighty Maker. The highest criteria of age are afforded by the nippers; the next highest, by the grinders; and the least, by the tushes.

At the time of the foal's birth, or within three or four days after it, the first and second grinders of both jaws protrude through the gums, and are very large in proportion to the size of the jaw. About seven or eight days after birth, the two central nippers will be seen, as represented in *Fig. 1, Plate I.*; and though they afterwards seem small in comparison with the permanent teeth of the second set, they at present appear so large as to fill the front of the mouth. Before the end of four weeks, the third grinder protrudes both above and below; and before the end of six weeks, two nippers, additional to the two first, and at the sides of them, will protrude both above and below, so that if you, on raising a colt's lips, find that he has only four nippers, two in each jaw,

you will know that he is a week old; but if, instead of four, he perceives eight, as in *Fig. 2, Plate I.*, you may know he has been dropped at least a month. At the end of two months after birth, the two first nippers will have attained their full height; and before the end of the third month, the second pair will be on a level with the first. From the third month till between the sixth and the ninth, both pairs of nippers will begin to be a little worn, and their outer edge, which was originally somewhat sharp and raised, will be reduced to a level with their inner edge. Between the sixth month and the ninth month, a third pair of nippers will protrude from above, and also a third pair from below; thus completing the colt's set of incisors, as in *Fig. 3, Plate I.* From this time till between the second and the third year, the several pairs of nippers will undergo change, and indicate age, only in their gradual wear. The foal's nippers—altogether twelve in number, and technically called milk-teeth or foal-teeth—are easily distinguished by their smallness and whiteness from the permanent ones which succeed them; they bear considerable resemblance to the foreteeth of a man; they are rounded in front, and somewhat hollow behind; and, previous to their being worn to a level by use, they possess a cutting surface, with the outer edge rising slantingly above the inner edge. When the animal is a year old, the first and the second pairs of nippers are nearly level on the surface, and the third pair have lost some of their slant and sharpness; and 'the mark' in the first pair is wide and faint; in the second pair, darker, longer, and narrower than in the first; and in the third pair, darker, longer, and narrower than in the second. Either at the completion of the first year, or soon afterwards, the animal gets a fourth grinder, so as to have six nippers and four grinders above, and the same number below; and from these indications—liable, however, to a little variation from differences in the time of weaning, and in the nature of the food subsequently used—its age may be accurately known. At the age of eighteen months, all the nippers are worn flat; and the mark in the central pair is much shorter and fainter than at twelve months, while that in the other pairs is also much changed; and at the age of two years, the indications in the mark of the nippers are increased, the fifth grinder protrudes both above and below, and the front or first grinder gives way, and is succeeded by a large and permanent tooth, the first of the set or series belonging to the adult horse.

The teeth of the second or permanent set begin to be secreted even at the foal's birth; they slowly and gradually grow beneath the roots of the first, pressing upon them, and causing them to be taken progressively away by the absorbent vessels; and in general they continue this process till the crowns of the milk-teeth are quite deprived of their roots, and drop out; but in a few instances they push so far by the side of the milk-teeth,

rather than right beneath their roots, as to occasion their temporary transmutation into what is technically called *wolf's teeth*. The crown of a milk-tooth pressed sideways by its successor is pushed out of its place to the forepart of the first grinder; it remains there for a considerable time, causing soreness of the gums, and sometimes excoriation in the cheek; and, very generally, it cannot wisely be left to the slow process of absorption for removal, but must be forcibly extracted. The period between the fall of the first pair of milk-nippers, and the full growth of their successors, affords a well-defined indication of age, and is often distinguished by difficulty in the colt's grazing, or by a necessity for his being partly fed with cut food, or with mashes and corn. At three years of age, the teeth of the colt will consist of the central pair of nippers, large and growing; the other two pairs of nippers wasting; and six grinders above and six below, the first and the fifth level with the central ones, and the sixth protruding. The 'mark' in the central nippers is long, narrow, deep, and black; that of the pair next the central ones is nearly extinct; and that in the third or corner pair is very much reduced. The appearance of the mouth at this time is shown in *Fig. 4, Plate I*. The indications of age here are so many and strong—especially those afforded by the lowness, largeness, sharpness, and broad mark of the new or central nippers, and by the comparative smallness and the worn condition of the other nippers—that a novice might suppose nothing to be more easy or certain than the identifying of a three-year-old colt. Yet this is precisely the period when rascality makes its first great attempt to deceive the horse-purchaser. "The ages of all horses used to be reckoned from May; but some are foaled even so early as January, and being actually four months over the two years, if they have been well nursed and fed, and are strong and large, they may, with the inexperienced, have an additional year put upon them. The central nippers are punched or drawn out, and the others appear three or four months earlier than they otherwise would. In the natural process they could only rise by long pressing upon, and causing the absorption of the first set. But opposition from the first set being removed, it is easy to imagine that their progress will be more rapid. Three or four months will be gained in the appearance of the teeth, and these three or four months may enable the breeder to term him a late colt of a preceding year. To him, however, who is accustomed to horses, the general form of the animal, the little development of the forehead, the continuance of the mark on the next pair of nippers, its more evident existence in the corner ones, some enlargement or irregularity about the gums from the violence used in forcing out the teeth, the small growth of the first and fifth grinders, and the non-appearance of the sixth grinder, which, if it is not through the gum at

three years old, is swelling under it, and preparing to get through,—any or all of these circumstances, carefully attended to, will be a sufficient security against deception."—[*Youatt on the Horse.*]

At three years and a half of age, or between that period and four years, the second pair of grinders and the second pair of nippers will be shed, the central pair of nippers will have attained nearly their full size, the second pair of new or permanent nippers will be beginning to protrude from the gum, and the third or corner pair of nippers will be worn down, diminished in breadth, and divested of a considerable portion of their mark. Any attempt of the horse-dealer to give the animal's mouth at this time the appearance of an additional year, may easily be detected by a similar examination to that for discovering the fraud upon a three-year-old colt. At four years of age, the permanent central nippers have attained their full size, and are beginning to lose a portion of their edge and of their mark; the second pair of permanent nippers are partially developed, and have a deep mark, extending quite across them; the corner nippers are larger than the second pair, yet have diminished in their own size, and almost wholly lost their mark; the sixth grinder has attained the same level as the other grinders; and in males the tushes begin to appear, though in mares only the germs of the tushes as yet exist, and even these only in the chambers of the jaw. The appearance of the mouth of a four-year-old colt is shown in *Fig. 5, Plate I*. Strenuous efforts are usually made by dishonest dealers to pass off a four-year-old colt for a five-year-old horse; but these may be detected by the unworn condition of the first and second pairs of nippers, by the smallness and unmarkedness of the corner nippers, by the embryo condition of the tushes, by the smallness of the second grinder, and even by the comparative thickness and small depth of the whole mouth. The tushes, however, if treated as the sole criterion, may possibly occasion the animal to be pronounced younger than he really is; for while they cannot be forced by knavish practice into a greater advance of development upon nature than a few weeks, they may fail to be naturally developed till the animal is four and a half years of age.

At about four and a half years of age, or between that period and five years, the central nippers are considerably worn, the second pair are beginning to show evidences of usage, the third or corner pair of the foal set are shed, the corner pair of the permanent set are beginning to appear, and the tush, in general, is half an inch in length, and has externally a rounded prominence, with a groove on each side, but is evidently hollow in the interior. At this stage, the colt becomes, in popular language, a *horse*; and the filly becomes a *mare*. At five years of age, the corner nippers are quite up, and have their mark long,

deep, and irregular; the two other pairs of nippers show evidence of increased wearing; the tush is much grown, and has nearly lost its grooves and become regularly convex, but is still concave within, and retains most of the sharpness of its edge; the sixth grinder is quite up; and—what forms by far the most distinctive criterion of a five-year-old animal, as distinguished from a late four-year-old—the third grinder is shed. A knave may force up the nippers a few months, and the tushes a few weeks, before their time; but he cannot, except in very extraordinary circumstances, occasion a premature shedding of the third grinder. At this stage, the horse, as to the state of his teeth, has experienced his last change, and approached within a degree of perfection; for he never sheds his tushes or his last three pairs of colt grinders. The appearance of his mouth at five years is represented in *Fig. 6, Plate I.*

The fifth year being the period at which the animal is provided with his full set of permanent teeth, we are henceforth compelled in judging of his age, to seek for other signs; and these are to be met with in the alterations which the teeth themselves undergo, particularly the faces or wearing surfaces of the incisive teeth. Thus at six years, the central nippers have lost their mark, and possess instead of it a slight discoloration and irregularity; the second pair of nippers have their mark shorter, broader, and fainter than before; the corner nippers have the edges of their enamel more regular before, and show evidences of wearing on the surface; the tush is full grown, and is convex without, and concave within; the third grinder is distinctly up; and all the other grinders possess one level of surface. At this stage, the teeth of the animal, regarded in the aggregate, are in their perfect condition. At seven years, the second pair of nippers of the lower jaw, as well as the first, have wholly lost their mark; the corner nippers of the lower jaw have lost a considerable portion of their mark; and the tush is rounded on the point and the edges, and beginning to be rounded in the interior. At eight years, all the nippers of the lower jaw have totally lost their mark; and the tush, in all respects, is more rounded than before. *Fig. 7 in Plate I.* represents the lower jaw of a horse with the corner teeth undergoing their third change, and the pits in the others almost or quite obliterated.

As all criteria of age have now ceased to exist on the nippers of the lower jaw, a method of artificially renewing the mark on these teeth was invented by a rascal of the name of Bishop, and is still well-known under the appellation of *bishoping*. The man who practises this knavery, throws down a horse of eight or nine years of age, and with an engraver's tool digs small holes in the corner nippers, and small irregularities in the other nippers, and then so touches or burns these with a heated iron as to make them resemble the

mark in a horse of seven years of age. But the trick is too coarse in its own execution, and too much out of keeping with the other appearances of the animal's mouth and body, to deceive an experienced or even a careful eye.

The criteria which we have given of a horse's age, from a few weeks after foaling up to eight years, are tolerably uniform and certain, yet must not be regarded as without exceptions or as infallible. In some individuals the tushes have been found blunted and rounded at eight years old; in others, they appear still sharp and curved at eighteen. A stable-fed horse will lose the mark sooner than one fed in the fields; and a horse which has the habit of crib-biting may lose it so fast as, at some stages of his lifetime, to appear to even the best judge twelve, twenty, or twenty-four months older than he really is. Under the old system, too—which always calculated the age of horses from the first day of May—the most experienced judge might have been unable to say whether any given animal was a late foal of one year or an early foal of the next.—But from eight years till twenty-one, the criteria become increasingly indistinct; and after twenty-one, they amount to little more than one amassed indication of the last stage of existence. The mark of the nippers of the upper jaw remains for a considerable period after that of the lower nippers is effaced; so that—in a loose sense, or with rather large allowance for variations under diversified circumstances—the extinction of the mark in the central upper nippers may be viewed as indicating nine years of age, the extinction of the mark in the second pair of upper nippers as indicating ten years, and the extinction of the mark in the corner upper nippers as indicating eleven years. The shape of the upper surface of the nippers affords a proximate criterion of age from eight years of age to twenty-one. At eight years, all the nippers have an oval surface, the length of the oval extending parallel with the jaw, or from tooth to tooth; at nine, the central nippers are a little rounded, or have lost some of their oval outline, and are slightly separated from each other; at ten, the other nippers begin to be a little rounded, and separated; at eleven, the second pair of nippers are completely rounded, and distinctly separated; at thirteen, the corner nippers are completely rounded, and distinctly separated; at fourteen, the central nippers have a somewhat triangular face; at seventeen, all the nippers have a somewhat triangular face; at nineteen, the central nippers are oval in a reverse direction to the original oval; and at twenty-one, all the nippers are oval in a reverse direction to the original oval.

The general indications of old age are various and distinct. The teeth of an old horse are yellow, and sometimes brownish. The gums are worn and sunk; and occasion a portion of the stumps of the teeth to appear long and naked. The bars of the mouth, which in youth were al-

ways fleshy, and formed a series of distinct ridges, are now lean, dry, and smooth, with little or no rising. The eye-pits, which in youth generally appear fleshy, plump, and smooth, are now sunk and hollow, and make the animal look lugubrious and ghastly. A horse which was formerly grey is now white; a horse which was formerly all black, is now probably grey over the eye-brows, or over a large proportion of the face; a horse, which was formerly black, but had a star or blaze fringed round with grey, is now grey or whitish over much of the face; and most horses, according to the variety of their colour or constitution, sooner or later become flea-bitten over most of their body except about the joints. All horses, when very old, sink more or less in their back; some, which are naturally long-backed, become so sunk that a saddle can hardly any longer be found to fit them; and most become so stiff in their joints as to trip and stumble upon even a smooth and almost level road. But long before a horse is transmuted into one of the mere animated skeletons which are sometimes seen to drag themselves along the streets of a market town, every respectable farmer will have repudiated the cruelty of fastening it under a harness.

Age of Black Cattle.—The horn of a cow is often regarded as affording, in the number of its rings, a distinct criterion of the animal's age. The horn of a heifer, in ordinary cases, remains smooth or unprotuberant till the expiration of the second year of the animal's life; a circle of thicker matter, or a kind of horny button begins then to be formed, and is completed in a twelvemonth; this circle of thicker matter moves next year from the head, or is impelled by a cylindrical growth of the horn; another circle of thicker matter is then begun to be formed; and, after a second twelvemonth, is also impelled outward by a cylindrical growth; and these alternations of ring and cylinder follow each other year after year, during the whole period of the animal's existence. Hence, were the growth of the horn quite uniform in all cows, and were the alternations of ring and cylinder in each horn always distinct, the most common observer, simply by counting the number of rings on any cow's horns, and adding two to their sum, ought to be able to determine unerringly her age. But though two or three of the earlier rings are usually quite distinct, the later ones are often exceedingly confused; so much so that the two horns of one individual sometimes appear to disagree with each other to the amount of two entire rings. Any heifer, too, which goes to the bull when she is about two years of age, immediately forms the first ring of her horns; and if judged by the common rule, would ever afterwards be pronounced a year older than she really is. A knavish cattle-dealer, besides, can easily rasp off two or three rings from the horns of an unsaleably old cow, and can so smoothen the rest of the horns as to make it look in good keeping with the portions from which he rasps the rings.

Let any sober-looking cow appear in the market with neat, small, smooth, glossy horns; and a young farmer, if not simpleton enough to construe these horns into indications of handsomeness and mere middle-agedness, may pretty distinctly learn from them that the animal is in extreme old age, and has been doctored for the market by heartless knavery.—The rings in the bull's horns do not begin to appear till he is five years of age, and are often or even usually too confused to be counted. The horn of the ox is so very strongly modified by his peculiar condition as to be totally unlike that of the bull; and the horn of the heifer, as we have seen, is immediately and powerfully affected by the early commencement of gestation; so that the horn's configuration and peculiarities are indicative rather of constitution than of age.

The teeth of the cow afford criteria of age which possess almost perfect certainty, and are nearly incapable of being artificially altered. Newly born calves, indeed, present a diversity of appearance, corresponding to excess or deficiency in the average period of the cow's gestation; and the cow from six to nine years of age admits of only such conjectures respecting her age as may be a few months in error; but, with these exceptions, the criteria are not only certain but exact,—and they have also the recommendation of existing solely in the incisors or front teeth, so as to be easily seen. At birth, in ordinary circumstances, the two central incisors either are protruding through the gum, or have actually attained a considerable size. About the middle or end of the second week, the second pair appear; at the end of the third week, the third pair; and at the end of the fourth week, the fourth or last pair. The edges of the teeth are exceedingly sharp; and their enamel covers their crown, but does not enter into their composition. The wearing of the edges now constitutes for some time the chief criterion; yet this occurs, not across the top of the teeth, but a very little out of the line of their inner surface; and it, in consequence, does not, till about the third month, begin to destroy the exceeding sharpness of the edges. At six weeks, the first pair are evidently worn; at two months, the second pair; at three months, the third pair; and at four months, the fourth pair. At three months also, the wearing down of the edges is observable; and at four months, this has produced a degree of flatness in the surface of the teeth, with a broad line in the centre. About this time commences an absorption which slowly but gradually diminishes the size of the teeth, makes them slowly shrink from one another, causes the inner edge to be more worn down than the outer one, and occasions the form of the mark to be changed from a broad line to a sort of triangle. At eight months, the central pair of incisors are so much diminished as to be not more than one half of the size of the next pair; at eleven months, the second pair are diminished, and both this pair

and the central pair have very visibly shrunk, so as to leave intermediate spaces; at fifteen months, the third pair are diminished, and no two teeth are in mutual contact; and at eighteen months, all the incisors are so dwarfish and so far shrunk from another, that an inexperienced examiner wonders how the animal can contrive to eat a sufficient quantity of provender.

During the whole of this process of absorption, not only the roots of the teeth as in man and the horse, but also the body and the crown, have been diminishing; and, in its latter stage, or after the eighteenth month, it becomes slower in its progress, operates upon the pairs of teeth in the order of their age, and so pertinaciously reduces them that each tooth is eventually no larger in the body than a crow-quill. During four or five months following the eighteenth, the central pair of incisors waste slowly away till they attain their minimum size. At the end of the second year, or a little before, the central pair of the permanent teeth push out the wasted remnants of their predecessors, and begin slowly to elevate their own body, large, spreading, and massive. At three years, the second pair of permanent incisors are well up. At four years, the third pair of permanent teeth are up; and the corresponding pair of milk teeth will sometimes be so huddled behind them, as to give great annoyance to the animal, and to require to be extracted. At five years, the fourth or last pair of permanent incisors have appeared, but are small; and the central pair are beginning to be worn down in a flat or slightly inclined direction at the edges. At six years, the last pair of incisors are full-sized, the flattening of the top extends over all the incisors, and the central pair begin to show a dark line in the middle, bounded by a line of indurated bone. At seven years, in ordinary circumstances, the dark line with bony boundary appears in all the teeth, and a second, broader, and more circular mark appears within it in the central pair; and at eight years, this second and more circular mark appears in all the incisors except the last pair; yet from six till nine years, the criteria are far from being exact, and will be modified, to the amount of several months, by the manner in which the animal is fed. At nine years, a process of absorption, similar to that which reduced the milk-teeth, but neither so rapid nor so powerful, has commenced, the central pair of teeth have become visibly smaller than their neighbours, and the two dark marks have been fused into one in all the teeth except the corner pair. At ten years, the second pair of incisors, as well as the first, are diminished in size; and the mark in all is smaller and fainter than before. At eleven years, the third pair are diminished; and all, except the corner pair, show a visible decrease in the mark. At twelve years, the corner pair are diminished; and the other three pairs have almost wholly lost the mark. In subsequent years, the teeth progressively dwindle and wear away; and after the fourteenth or the

sixteenth year, they belong to an old and exhausted animal, and rarely serve to maintain her longer in full condition. A cow is seldom of full or fair value to a dairyman after she is twelve years of age. The same criteria which show the successive ages of the cow, show those also of the bull and the ox.

Age of Sheep.—The age of all horned sheep may, in a general view, be known from the rings of their horns; yet not with much more certainty, nor with more protection from the tricks of knavery, than in the case of horned cattle. The horn of the sheep appears in the first year, and very often at birth; and it grows a ring annually to the end of life.—The teeth, as in the case of black cattle, furnish better criteria than the horns. The sheep, in its second year, has two broad teeth; in its third year, four broad teeth; in its fourth year, six broad teeth; and in its fifth year, eight broad teeth. But after its fifth year, its age is known chiefly by the wearing of the teeth, and, in many or even most cases, cannot be accurately or even very proximately determined. The lamb, at birth, has two milk teeth, and in the course of a few weeks, obtains all the other pairs. The sheep, about the end of its first year, loses the central pair of the milk teeth; at eighteen months, loses the second pair of the milk teeth; and at three years, displays only such teeth as are even and pretty white. The teeth of the full-mouthed animal—the sheep of five years of age—seldom continue long sound, but some become blunt, loose, black, and broken; and hence many sheep which have passed their prime—especially such as have fed much on turnips—are, in technical phrase, broken-mouthed. The criteria of the sheep's age, while very indefinite after five years of age, are not even certain in the earlier years, and must be understood as supplying only a general rule; for the permanent teeth appear in some cases much earlier, and in others considerably later, than the normal period.—*Magazine of Domestic Economy.*—*Buffon's Natural History.*—*Gibson on Horses.*—*Youatt on the Horse.*—*Culley on Live Stock.*—*Clater's Cattle Doctor.*—*Youatt on Cattle.*—*Spooner on the Sheep.*—*Quarterly Journal of Agriculture.*—*Loudon's Ency. of Agriculture.*—*Cuvier's Animal Kingdom.*

AGE OF PLANTS. Either the average total existence of any species of plants, or the particular period of its existence at which any individual plant has arrived. The existence of a plant, in a general view, is commensurate with its performance of organic functions, and does not include the exertion of vital energy, either by reproduction or otherwise, after the plant is eradicated, cut down, or dismembered; and the existence of the short-lived kinds of plants terminates with the completion of a single fructification, while that of the long-lived kinds includes many fructifications, and extends beyond the last of them till exfoliation ceases, or the root is torn up or dis severed from the stem. Some of the minute

fungi, commonly termed *mould*, live only a few hours, and seldom exist above a few days. All plants, in reference to their total period of existence, are usually distributed into three classes,—*annuals*, *biennials*, and *perennials*. An *annual*, as generally understood, germinates, fructifies, and dies off at the roots in the course of a single season; a *biennial* germinates and grows in one season, and fructifies and dies off at the roots in the second season; and a *perennial* fructifies oftener than once, and may perform organic functions during any number of years from three to several thousands. Familiar examples of annuals are oats and corn-poppies; of biennials, cabbages, and winter-wheat; and of perennials, white clover, perennial rye-grass, docks, shrubs, and trees. Some plants, however, as stockgillyflowers, are either annual, biennial, or perennial, according to the culture they receive; some, as many varieties of turnips, are, out of seeds of the same plant or specimen, prevailingly biennial but occasionally annual; some, as the common nasturtium or Indian cress, *Tropæolum minus* or *major*, are annuals in our country but perennials in lower latitudes; some, as wallflowers and hollyhocks, are nominally biennial, but really live and flourish during six or seven years; some, as many of the herbaceous species, are perennial only in a very low sense, living scarcely longer than some nominal biennials; and some, as the oak, the yew, the cypress, the cedar, and the adansonias, are perennial in a very high sense, flourishing and maintaining great energy during many centuries.

No rule is known for making more than a rough guess at the age of a herbaceous perennial plant; and no infallible rule is known for determining the age of even long-lived and ligneous perennials. The well-known rule of counting the number of zones or circular layers of wood, and reckoning each zone for a year, applies only to exogenous or dicotyledonous shrubs and trees; and, though far from being uniformly correct, affords the best means, as far as concerns that great and important class of plants, of forming an approximate judgment. The practice of this rule requires the tree to be felled, and counts the zones or circular layers, from the pith of the tree to the circumference, as they appear on the transverse section of the base of the trunk. The zones are formed in all ligneous dicotyledonous plants—[see article DICOTYLEDONOUS PLANTS]—by the formation of alburnum or soft wood during the plant's periodical activity, and by the consolidation of this into duramen or timber during its periodical repose; and hence each zone is supposed to be completed exactly during a year or circle of the seasons. "This method," says DeCandolle, "is not liable to much error, and is a simple criterion to ascertain the age of a tree; but the inspection of these concentric circles must be made with the greatest care. By their number they give the age, and the degree of their thickness gives also the rate of their increase; therefore they should be mea-

sured as well as counted. My plan is as follows: When I have got a section of an old tree, on which I can see the circles, I place a sheet of paper upon it, extending from the centre to the circumference. On this paper I mark every circle, showing also the situation of the pith, the bark, the name of the tree, the country where it grew, and any other necessary observations. I also mark in a stronger manner, the lines which indicate every *ten years*, and thus I measure their growth at *ten years'* intervals. Measuring from centre to circumference gives me the circles, doubling this I have the diameter, and multiplying by six I have the circumference." The learned professor then presents a table of the periods of increase in the diameter of various trees; an inspection of which proves that every tree, after having grown rapidly when young, seems at a certain age to take a regular march of growth, which may perhaps be accounted for by supposing that young trees have more room to expand in, are less pressed by the roots and branches of their neighbours, and may not have penetrated down to a hard, arid, or otherwise unfavourable soil; and also, that as trees advance in age, they still continue to form layers as thick as they previously did subsequently to the period of rapid growth. If such tables were multiplied to a sufficient extent, they would form data from which, by ascertaining the circumference of a tree, its age might be known without having recourse to the destructive process of cutting deep into the growing timber. "If," says DeCandolle, "one cannot get a transverse section of a trunk, then one must seek for old specimens of each kind, the date of whose planting is known, measure their circumference, deduce their average growth, and calculate from them the age of other trees of the same kind, always keeping in mind that young trees grow faster than old ones." But a recurrence of cold weather after a warm or forward spring may so check vegetation as to occasion the formation of two zones in one season; and an opposite condition of the seasons, or the partial and temporary injury of the plant, may cause the omission of a zone or the fusing of two zones into one. Hence the celebrated naturalist Duhamel has shown that a tree of ten years of age has sometimes upwards of twelve zones, and that a tree of twenty years of age has not always twenty distinct zones. The rule which makes every zone represent a year, therefore, is essentially erroneous, and ought to be employed only as a good aid to conjecture. Or if an observer know the exact age of any individual tree of a species, vegetating in what appears an average situation for facilities of growth and development, he may count its layers and measure its diameter, and institute these and the known age as proportionals for determining the age of any other individual trees of the species. Yet even this method of attaining a nearer approximation is modified by limits in a tree's progress of ex-

pansion which will be noticed in our article on GROWTH: which see. In any circumstances, a cautious observer will state his inference respecting a tree's age to be only a well-founded conjecture, not an actual determination.

The rule for conjecturing the age of ligneous plants of the monocotyledonous or endogenous class is even more indefinite than the rule for the dicotyledonous class. No criteria by zones or diameter here exist, and the only indications of progressive age are circular marks on the exterior of the trunk, which have been left at intervals by the decay of the fibres of the annual leaves,—and even this occurs but partially in any species, and are totally wanting in some,—for in the young parts of plants, they are often too slight to be discernible, and in the old parts, they are frequently effaced. The true rule, therefore, applies rather to the height of the plant, than to the character or appearance of its stem. When any individual plant is the subject of investigation, the inquirer ascertains the height of some other individual of the same species whose age is known to him, or adopts its height as ascertained by some other person, and then uses the height and the age of this plant and the height of the plant under investigation as proportionals for determining the latter's age. The result is only a rough guess; but it is the best that can be obtained. When the wood of the interior of trees becomes so close in its texture that the passage of sap or pulp is prevented, or the formation of new vessels cannot be admitted, then it dies; and as all its moisture passes off into the younger wood, the fibres shrink, and are ultimately reduced into dust. The centre of the tree loses its vitality, while the outer parts continue to exist, and may thus live for many years before a total dissolution takes place. Yet Decandolle on this point says:—"As there is formed every year a ligneous deposit, and generally new organs, there is not among the vegetable creation place for that hardness or rigidity, that destruction of old and permanent organs, which constitutes properly the *death of old age*, and, consequently, that being the case, trees can only die from accidental causes. Trees do not die from age in the true sense of the word; they have no fixed period of existence; and, consequently, some may be found that have arrived at an extraordinary age."

Some instances of remarkable longevity in trees, both in our own country and in other lands, have been noted by naturalists, and are even, in some degree, known to the reading public. An elm tree, which grew at Morges on the banks of the lake of Geneva, and which fell down in 1827, measured about 18 feet in diameter at the base, and had 335 zones or concentric layers. An elm which formerly stood on Binsey-common measured 18 feet in diameter near the ground, and probably was an older tree than even the elm of Morges. An ivy plant, growing at Gigean, near Montpellier, was computed in 1814 by Decandolle to be

433 years of age. A lime tree, growing at Trons in the Grisons, was a celebrated plant in 1424, and had a circumference of 51 feet in 1798, and could not, at the latter date, be less than 580 years of age. A lime tree, at Neustadt in Wurtemberg, is known to have been a large tree in 1229, and had a circumference $37\frac{1}{2}$ feet at six feet from the ground in 1831, and was computed, at the latter date, to have an age of between 700 and 800 years. A walnut tree, which grew at St. Nicholas in Lorraine, furnished a slab of 25 feet in breadth, and of proportional length and thickness, and is computed by Decandolle to have been not less than 900 years of age. A celebrated chestnut tree, growing on Mount Ætna, has a circumference at the base of 160 feet according to the minimum statement, and 180 feet according to the maximum statement; yet is regarded rather as a natural amassment of several contiguous stems, than as strictly a single tree. A chestnut tree, growing at Sancerra, measures 37 feet in circumference, was called the great chestnut tree six centuries ago, and is computed by Decandolle to be not less than 1,000 years of age. A chestnut tree, which grows in Lord Ducie's park at Tortworth, was called the great chestnut of Tortworth in the reign of John, and is believed to have been growing in the reign of William the Conqueror. Some cedars now growing on Lebanon are computed to be at least 1200 years old; and seven which continued to grow there in 1789, were believed to be contemporaries of the wondrous, ancient forest of cedars, which supplied timber for the temple of Jerusalem, and were 'the glory of Lebanon.' An oak, which was noticed by Evelyn as growing at a place called Rivelin, measured 36 feet in circumference at a foot from the base, and is computed to have been 864 years of age. An oak, which was felled in 1812 in the Polish province of Samogitia, measured 39 feet in circumference near the base, and is believed to have been at least 1,000 years of age. An oak, which was felled in the Ardennes in 1824, contained within its trunk some coins and medals of the ancient Samnites, and is supposed, from that circumstance, to have been at least 15 or 16 centuries of age. The celebrated oak of Calthorpe, near Wetherby, measures 78 feet in circumference close to the ground, and is computed to have an antiquity of upwards of 2,000 years. Among other individual oaks in Great Britain, distinguished for their size and their great age, are the oak of Elderslie, the birth place of Sir William Wallace, in the vicinity of Paisley; the Torwood oak, in the neighbourhood of Stirling, another relic of Scotland's champion of which some noticeable remains existed within these few years; the oak of William Rufus, in the New Forest in Southamptonshire; Queen Elizabeth's oak, at Heveningham, in Suffolk; the Whinfield oak, in the vicinity of Appleby; Fisher's oak on the road to Tunbridge; and Herne's oak, in Windsor forest. The yew trees of Ripon in York-

shire, commonly called the yews of Fountain's abbey, are computed to be about 1,290 years old ; and the largest of them had, in 1775, a circumference of $26\frac{1}{2}$ feet. Two yew trees in Kent, the one in the churchyard of Stalesfield, and the other in that of Easling, measure each 27 feet in circumference at the height of four feet from the ground, and are believed to be about 1,300 years of age. A yew tree, which was growing in 1660 in the churchyard of Brabourne in Kent, but all local tradition of which is lost, measured at that time very nearly 60 feet in circumference at the base, and is believed to have been 2,880 years of age. There is at present a yew tree growing in Darley churchyard, near Matlock, of the girth of 33 feet. It is the opinion of Decandolle, that of all European trees the yew is that which attains the greatest age. "I have measured the deposits of one hundred and seventy years ; Oelhafen has measured one of one hundred and fifty years ; and Veillard has measured one of two hundred and eighty years. These three measurements agree in proving that the yew grows a little more than one line annually in the first one hundred and fifty years, and less than a line from one hundred and fifty to two hundred and fifty. If for very aged yews we take the average of one line annually, it is probably an admission beyond the truth ; and thus in estimating the number of lines and years as equal, we make them younger than they really are." Some cypresses, which were growing in 1776 in the palace-garden of Grenada, were supposed to be then 800 or 900 years old. A species of cypress (*Cupressus disticha*), which grew near Oaxaca in Mexico, and which is said to have sheltered the whole army of Cortes, measured nearly 118 French feet in circumference, or $37\frac{1}{2}$ feet in diameter, and was computed by Decandolle to have withstood the deluge, and been in existence before the creation of man. "But," says Humboldt, "on examining it narrowly, M. Anza observes, that what excites the admiration of travellers is not a single individual, but that three united trunks form the famous Sabino of Santa Maria del Tuli." The fact of the threefold nature of the stem, seems to have escaped the notice of some writers ; it is of importance in determining which is really the largest organic monument of our planet. There is another cypress at Chapultepec in the same region, which is said to be 117 feet 10 inches round. If the measurement here given be correct, and the tree consists only of one stem, we are entitled to regard this Mexican cypress as the most gigantic and ancient tree hitherto discovered on the globe. The cerroylon of the Andes, a monocotyledonous tree, attains a height of 180 feet, and is supposed to live about 900 years. The celebrated dragon-tree of Teneriffe, another monocotyledonous plant, is alleged by tradition to have been as large and as hollow at the discovery of the island in 1402 as at present ; and, when measured by Humboldt, it had a circumference of 45 feet near the ground, and a diameter of 16 feet. The won-

derful size and appearance of this tree excited the admiration of Humboldt, who thus describes it :—"We were told that the trunk of this tree, which is mentioned in some very ancient documents as marking the boundaries of a field, was as gigantic in the fifteenth century as it is at the present moment. Its height appeared to us to be about fifty or sixty feet ; its circumference near the roots is forty-five feet. * * The trunk is divided into a great number of branches, which rise in the form of a candelabrum, and are terminated by tufts of leaves, like the yucca which adorns the valley of Mexico. It still bears, every year, both leaves and fruit. Its aspect feelingly recalls to mind 'that eternal youth of nature' which is an inexhaustible source of motion and of life. This giant plant was laid prostrate by a tempest in 1822." It has been satisfactorily ascertained, that olive trees will live in favourable situations for 300 years. Greuw, in the year 1400, cut his name on two boobabs, and Petiver did the same thing 149 years afterwards. In 1749, Adanson saw these trees, and at that period they had increased seven feet in circumference since the time of Petiver, being an interval of 200 years. These trees are, however, sometimes found to acquire a perimeter of 435 feet ; from this it is inferred that they must live many thousand years. One of the most curious and beautiful of nature's productions, is the banian or burr tree, the *Ficus Indica* of botanists. Each tree forms in itself a grove, composed of numerous stems connected together, some of which are of the size of a large tree. On the island of Nerbuddah, near Baroach, in Hindostan, there is still standing a celebrated banian, called the Cubbeer Burr. The tradition of the natives is, that it is three thousand years old. It is supposed by some to be the same tree that was visited by Nearchus, one of Alexander the Great's officers. The large trunks of this tree amount in number to 350, the smaller ones exceed 3,000, and each of these is constantly sending forth branches and hanging roots to form other trunks. The circumference of this remarkable plant is nearly 2,000 feet. The long period required to ascertain the age of trees, renders our knowledge on this subject very imperfect ; and it will probably long remain so until records are established by scientific institutions, to ascertain the ages of such trees as are public property. See articles GROWN and TREES.

AGENT. An organic power in the animal body, to perform a natural function ; a medicinal power in drugs, to attack and dispel a disease ; a chemical power in inert substances, to change the properties or composition of other substances ; a chemical power in manures, gases, electricity, or weather, to effect important modifications on soils or crops ; in mechanics, the powers or forces employed as the first movers of machinery, such as the strength of animals, the elastic power of steam, the weight of water, and the force of wind :

and, in general, any power not intellectual or mechanical, which produces visible effects. In the moral or metaphysical sense—which is the fundamental sense, or that whence all the other meanings of the word are derived—every being endowed with any degree of intelligence is an agent whenever he acts, and man, most eminently is an agent, not only when acting, but when thinking.

AGENT. An inferior officially acting for a superior in the management of an estate, of a farm, or of part of a farm. Agents are of various classes, and have various powers; and sometimes two or three of the same class, or with the same powers, have different names. To remove confusion, therefore, we shall here notice all the principal ones, and shall make references to this article at the several alphabetical places where their designations occur.

Persons who conduct the business of an estate are the most important class of agents, and are usually called *agents* in Ireland, *factors* in Scotland, and *stewards*, *land-stewards*, or *resident managers* in England. They are of three classes,—the agents, factors, or stewards of absentee landlords,—the agents, factors, or stewards of resident landlords, who, from nonage, ignorance, disinclination, or other cause, take no interest in the details of management,—and the agents, factors, or stewards of resident landlords, who exercise personal inspection over their estates, maintain personal acquaintance with the condition of their farms and tenants, and bestow considerable time and care on all the more important departments of business. The first class usually wield all the power of the proprietor without any effective control; the second class wield all the proprietor's power, subject occasionally to a control more mischievous than beneficial; and the third class are rather the assistants of proprietors than their representatives, and possess only limited and indirect powers of either achieving good or inflicting evil. Any farmer will see at a glance that an estate under the third kind of agency is likely to be incomparably better managed for the interests of both the proprietor and the tenant, than an estate under the first or the second kinds; and that, so far from being exposed to the privations and mischiefs of mere delegated power, it enjoys or ought to enjoy all the advantages of the proprietor's personal supervision, aided by that of an intelligent assistant. But agents of the first and the second classes possess responsibility of the highest order, and wield powers which are likely to have a heavier influence upon tenantry than the direct powers of proprietors; and hence, except when they are men of high qualifications and fine moral character, they rarely fail to be more or less scourges of society, and to earn for themselves an inglorious reputation. A large proportion of land-stewards are mere men of business or legal practitioners, without any fair degree of acquaintance with rural affairs, far more

solicitous to obtain prompt payments of rent than well informed as to the kind of treatment by which these are best secured,—and generally ignorant respecting at once the wise management of tenantry, the real resources of estates, and the true interests of proprietors; and they, in consequence, become capricious, short-sighted, domineering, and oppressive, driving good tenants into difficulties, privations, or despair, provoking worthless tenants into litigiousness and acts of wanton damage, and converting their very zeal for regular and large proceeds of rent into the certain and rapid impoverishment of at once the tenantry, the estate, and the rent-roll. In Ireland especially this is felt to be the case in a great proportion of instances. "The agent's duties generally," said a witness, himself a barrister-at-law, in evidence before the Parliamentary Commissioners in September 1844, "an agent's duties generally consist in enforcing the rents by the aid of his bailiffs, and putting money into his landlord's pockets, and a per-centage into his own, and in nothing else." Other land-stewards, however, besides being, in all respects, professionally qualified for their responsible office, are either so strictly gentlemen as to scorn every thing paltry or dishonourable, or so truly christian as to be incapable of any conduct but such as is just, generous, or noble; and such men have, in not a few instances, acquitted themselves to the full as wisely and patriotically as if they had been, in their own persons, the very best of landlords. See articles **ABSENTEEISM** and **MIDDLE MEN**.

Every land-steward ought to possess skill in accounts, acquaintance with the law of landlord and tenant, considerable knowledge of human nature, large experience in negotiating with equals and inferiors, perfect integrity of moral character, much suavity and firmness of temper, and a full knowledge of practical agriculture, of land-surveying, of planting, and of all the portions of science and mechanics which are connected with the explanation of agricultural phenomena, and the promotion of agricultural improvement. His skill in accounts is requisite for the correctness and good order of his numerous pecuniary transactions, not alone with the tenantry, but in connexion with his general management; his acquaintance with law is necessary for avoiding litigations, and inducing a liberal construction of the conditions of leases; his knowledge of human nature, and his experience in general society, are requisite for successful dealing with the variety and the occasional knottiness of character which he may have to encounter among tenants; his uprightness in moral principle and conciliatoriness in general manners, are essential for his commanding the respect of his people, dissuading them from folly and vice, and inducing them to resort to him as their counsellor and peacemaker; his knowledge of practical agriculture is requisite for his acting intelligently in the details of agricultural management

and negotiation, and even for his escaping the derision or mistrust of his people ; his knowledge of land-surveying is requisite for his advantageously laying out half-waste lands, and for his checking the proceedings of professional men ; and his knowledge of the principles of engineering, the laws of mechanical science, and the discoveries of chemistry, meteorology, electro-magnetism, vegetable physiology, and experimental philosophy, are requisite for his superintending processes of thorough-draining, laying out water-meadows, directing the construction of the mill and engine-works of the farmery, assisting in analyses of soils, explaining the phenomena of occasional failure in crops, directing a judicious selection and application of manures, detecting minute causes of depredations in the action of insects and fungi, encouraging eligible experiment in fertilizing and culture, and promoting the hundreds of other processes for improvements in farming which are suggested by the combined progress of scientific discovery and artistic skill. If it be said that few men possess all these qualifications, then the sooner every land-steward be required to possess them all the better ; and, in the meantime, let only him be selected for the next vacancy in the office of land-steward, who possesses as many of them as possible. Or if it be said that to require all these qualifications from a land-steward is to exact more from him than is required in a landed-proprietor, let it be understood,—first, that a steward really requires additional qualification to compensate for the care and energies which arise from the mere proprietorial zeal of the landowner,—next, that all landlords who manage their own estates would speedily find it their interest to task themselves up to the possession of the utmost possible amount of these qualifications,—and, thirdly, that, judging from the present rapid march of improvement, the time is not far off when every land-steward and every land-owner must either possess all these qualifications to the full, or incur the commiseration and scorn, not only of farmers, but of farmers' hinds.

The land-steward ought stately to reside either in the mansion of the estate, or in some other comfortable and equally central abode ; and if a portion of the estate lie at such a distance as not to be under easy supervision from his stated residence, he ought to have there a comfortable secondary residence, and to spend in it small periodical portions of his time. His professional apartments ought to be a principal office, a commodious business-room, a small ante-room, and a safe-keep or small fire-proof room ; and his professional furniture ought to include a general map of the estate, portable separate maps with accompanying registers, books of valuation of each field and tenement, rental-books, a general register of trees and copsewood, legal documents, a book of abstracts, a small laboratory, an agricultural library, and the instruments for survey-

ing, measuring, mapping, and levelling. Yet some of the details of furniture and appliances of management which are quite essential for conducting the agency of a minutely divided estate, farmed by ignorant peasant-tenantry in Ireland, would be quite useless and even absurd in the factorship of a largely divided, opulently tenanted, and intelligently farmed estate in the best agricultural districts of Scotland ; for in the former case the agent deals with a rabble and boorish crowd of potato-fed tenants-at-will, while, in the latter, the factor deals with a small body of well-conditioned gentlemen, almost or altogether his equals in both intelligence and rank.

A land-steward either may be the bailiff of a manor in his own person, or may enjoy the assistance of such an officer in the person of another man. When an estate possesses not the status of a manor, its powers of legal agency are wielded by the steward ; and when an estate does possess that status, these powers are wielded by the bailiff. A steward cannot bind his principal beyond the limits of his delegated authority ; for though, if he were a general agent, he would in every official proceeding bind his principal, yet, because he is an agent, or holds an appointment for only a particular purpose, he can bind no farther than to the extent of instructions given. A lease agreed for with an agent who acts under power of attorney, and executed by such an agent in terms of agreement made with him, binds the principal. The bailiff of a manor is appointed only to collect rents, gather fines, enforce forfeitures, and perform similar offices ; and having no interest or estate in the manor itself, he can neither make leases for years, nor enter into any other contracts which affect the property of the manor. Yet, simply in connexion with his collecting rents, and in order to prevent loss to his principal from the expiry of leases during the latter's absence, or incapacity, the bailiff has power to make leases at will, or to continue the quondam lessees in possession under the new character of tenants-at-will ; and he may also receive a special delegated power to grant leases for years,—that power, however, being only such as might be delegated to any other person, and not becoming identified with the bailiff's official character, and capable of being exercised only within the strict limits assigned in the act of delegation. A bailiff may repair the materials of a building, but cannot substitute one kind for another, as, for example, slate for thatch ; and, in general, he may do any thing which is obviously for his principal's benefit, but cannot, without his consent, do anything which might be construed to be for his disadvantage.

The principal subagents or assistants of the land-steward, on a large estate, or on one which consists of mutually detached portions, are the land-reeve, the book-keeper, the solicitor, and the land-surveyor. The land-reeve—also called the *woodward*, the ground-officer, and the stew-

ard's bailiff—is appointed over a district or department of the estate, and attends to the condition of the woods, the fences, the hedge-trees, the gates, the roads, the water-courses, and the buildings, to the stocking of commons, to the prevention of encroachments, and to the repression of all sources of damage whether among tenants or among interlopers and strangers. The book-keeper—also called the office-clerk and the under-steward—forms the registers of the estate, makes out rentals, keeps the accounts, and assists in all the more immediate and responsible duties of the stewardship. The solicitor, attorney, or law-assistant, is a professional person, occasionally called in, and is employed only when the steward does not possess a sufficient amount of legal knowledge and accountantship to perform the duties; he is not a desirable officiate upon an estate; yet, when unavoidably employed, he usually, for a comparatively small salary or allowance, collects the rents, keeps the accounts, and gives requisite advice to the other officers of the estate. The land-surveyor is likewise a professional man; and is employed, as occasions require, to measure and map portions of the estate, to act as a referee or an arbiter, and to effect an amicable adjustment of disputes.

The farm-steward—usually called in England the farm-bailiff, and in Scotland the *grieve*—is the farmer's chief assistant, and often his representative and second-self, upon a large farm of either tillage or mixed husbandry. He ought to have a tolerably good education, a knowledge of accounts, ability to measure work, land, and timber, and a thorough acquaintance with all the departments of practical farming, from the coarsest cases of the farm-yard to the nicest manipulations of the husbandman's art. He inspects and controls the field-workers and the ploughmen; he exercises all authority over the farm during the farmer's absence or temporary incapacity; he has charge of the corn-barn, the granaries, and the provision-stores; he performs all the nicer and more responsible duties of the farm, but seldom works with horses, or stoops to offices of drudgery or hard labour; and he ought to be active, considerate, shrewd, and upright,—constantly studying the combination of the interests of his master with the utmost possible comfort of the servants.—The bailiff and gardener, or the gardener and *grieve*, is a mongrel officiate between farm-steward and kitchen-gardener; he seldom excels in the duties of either of his capacities; and he is usually found only on farms of small extent and indifferent condition.—The forester or head woodsman has a similar charge over woodlands to that which the land-reeve possesses over an arable district of an estate; and he directs and superintends the operations of planting, pruning, rearing, barking, and felling trees, of making charcoal, and of forming, thinning, or otherwise managing fences, coppices, and plantations. The demesne-steward conducts

the management and business of the parks, lawns, and other home-grounds immediately around a mansion; he even extends his care over the whole of an estate, when it is small in extent, and wholly retained by its proprietor; he likewise wields influence in the stables, in the garden, and in other departments; and he may be regarded as discharging, within the demesne or the estate, the duties of a land-steward, a bailiff, and a forester, and, in some degree also, those of a house-steward.—Other officials than those we have named cannot properly be included in the class of agents, and will be noticed in the article FARM-SERVANTS: which see.

AGISTMENT. The eating of crops by cattle upon the ground, or the pasturing of another person's cattle for hire. "If," says Blackstone, "a man takes in a horse or other cattle to graze and depasture in his grounds, which the law calls agistment, he takes them upon an implied contract to return them on demand to the owner. He cannot, like an inn-keeper, retain them till payment."—The tithe exigible from crops eaten upon the ground, or from pasturage consumed by hire, is called the *tithe of agistment*. This tithe, in the case of eaten crops, is estimated according to the value of what is supposed to be consumed; and, in the case of grasslands, it is payable on clover and similar crops, when first fed and then permitted to run to seed,—on grass-crops first depastured and afterwards cut down,—and, with some exceptions, on whatever pasture lands within a parish are occupied by cattle which are untitheable as live stock, and are sold or removed from the parish. The agistment tithe is calculated from the time of the cattle being severally placed upon the land till that of their being turned off; and it is usually rated at one-tenth of the rack-rent of the land, or at one-tenth of the hire paid by strangers for the cattle's grazing, or at one-tenth of the rate usually charged in the neighbourhood for pasturing, or, in the case of feeding upon turnips, at such an estimated rate per head of cattle as shall correspond to the value of the crop. Exceptions to the payment of this tithe occur in the case of all depastured aftergrass of meadows which, in the same season, have yielded a crop of hay,—in the case of all stall-fed or straw-yard cattle, tithe being exigible from the cut or removed crops on which these are fed,—in the case of all cattle which become profitable to the tithe-owner by the production of young, or by being milked, or shorn,—and in the case of all working cattle which are employed wholly or partially within the parish, of all cows which are maintained for the supply of the farmer's family, of all sheep and oxen which are slaughtered for consumption on the farm, and of all young stock which are reared for the plough or the dairy, and not removed from their native parish.

AGREEMENT. The statement of conditions between tenant and landlord, on which a farm is

rented or leased. In England it needs to be made in writing for a lease of more than three years; and, though an unwritten one for a less period than three years will suffice, yet, for the sake of both parties, an agreement ought, in every case, to be in writing. In Scotland a lease of land is not susceptible of proof upon mere parole evidence, if for more than a single year; and either party is entitled to resile at the end of each successive year. An agreement to make a lease amounts, in equity, to an actual lease; but whether any particular agreement constitutes a present lease, or a lease to commence at some future period, depends on the intention of the parties, and must be ascertained from its own language. See article LEASE.

AGRICULTOR or AGRICULTURIST. A person who is skilled in the art and science of cultivating land. *Agricultor* is the pure Latin name, and *agriculturist* is the modified name in common English use. An agriculturist is a scientific person, and may or may not be engaged in actual farming; and a farmer is a practical person, and may or may not have a knowledge of the scientific principles of his art.

AGRICULTURAL CHEMISTRY. The science which professes to teach the application of the established principles of chemistry, in regular and systematic form, to the theory and practice of agriculture. "Agricultural chemistry," says Sir H. Davy in his opening lecture on this subject, "has for its object all those changes in the arrangements of matter connected with the growth and nourishment of plants,—the comparative values of their produce as food,—the constitution of soils,—the manner in which lands are enriched by manure, or rendered fertile by the different processes of cultivation."

In 1795 the Earl of Dundonald addressed a 'Treatise showing the intimate connexion that subsists between Agriculture and Chemistry,' to the cultivators of the soil in Great Britain and Ireland, and the proprietors of West Indian estates. The Earl, adopting the language and espousing the enlightened views of the French chemists of the day, drew together much elementary matter on the composition of earths and vegetables, and the treatment of soils for agricultural purposes on just chemical principles; but his lordship's book was generally disregarded as the speculation of a mere theorist unworthy the attention of 'practical men,'—as if practice alone is not almost as fruitful in mistakes as mere theory. Sir Humphrey Davy's course of lectures before the Board of Agriculture from the year 1802 to 1812, attracted some attention to the theoretical cultivation of agriculture, particularly the analysis of soils, the mutual effects of vegetables and the atmosphere,—the doctrine of manures,—and the proper rotation of crops. Since the publication of these lectures, in 1814, various important contributions to scientific agriculture, or in explanation of the *principles* which ought to

regulate the practice of the agriculturist, have been made both in our own country and on the continent. The writings of Berzelius, Mitscherlich, Mulder, Johnston, and Liebig,—of the latter especially—have developed the special and important bearings of chemical science on agricultural art in a way which must command the attention of all whose occupations or interests are connected with the cultivation of the soil.

"The development," says Liebig, "of the stem, leaves, blossoms, and fruit of plants is dependent on certain conditions, the knowledge of which enables us to exercise some influence on their internal constituents as well as on their size. It is the duty of the natural philosopher to discover what these conditions are; for the fundamental principles of agriculture must be based on a knowledge of them. There is no profession which can be compared in importance with that of agriculture, for to it belongs the production of food for man and animals; on it depends the welfare and development of the whole human species, the riches of states, and all commerce. There is no other profession in which the application of correct principle is productive of more beneficial effects, or is of greater and more decided influence.

"In addition to the general conditions, such as heat, light, moisture, and the component parts of the atmosphere, which are necessary for the growth of all plants, certain substances are found to exercise a peculiar influence on the development of particular families. These substances either are already contained in the soil, or are supplied to it in the form of the matters known under the general name of manure. But what does the soil contain? And what are the components of the substances used as manure? Until these points are satisfactorily determined, a rational system of agriculture cannot exist. The power and knowledge of the physiologist, of the agriculturist and chemist must be united for the complete solution of these questions; and, in order to attain this end, a commencement must be made.

"The *general* object of agriculture is to produce in the most advantageous manner certain qualities, or a maximum size, in certain parts or organs of particular plants. Now, this object can be attained only by the application of those substances which we know to be indispensable to the development of these parts or organs, or by supplying the conditions necessary to the production of the qualities desired.

"The *special* object of agriculture is to obtain an abnormal development and production of certain parts of plants, or of certain vegetable matters, which are employed as food for man and animals, or for the purposes of industry.

"The means employed for effecting these two purposes are very different. Thus the mode of culture employed for the purpose of procuring fine pliable straw for Florentine hats, is the very

opposite to that which must be adopted in order to produce a maximum of corn from the same plant."

Nutrient of plants.—There are two prevailing views in reference to the nutrient of plants: the one regarding it as wholly derivable from inorganic matter and decomposed organic matter, —the other, as partly or even chiefly from undecomposed though dead organic matter. The former of these views has been ably advocated by Liebig by reference to numberless chemical and physiological data; and even though it should not prove to be wholly correct, his essay can scarcely fail to exert a very modifying and improving influence on many important topics in the science of agriculture. The principal advocates of the opposite opinion are Boussingault, Saussure, Hermann, Payen, Mulder, and Madden. We shall present a condensed view, first of Liebig's theory, and next of that of his opponents.

VIEW OF THE THEORY THAT THE NUTRIMENT OF PLANTS IS DERIVED SOLELY FROM INORGANIC MATTER.

There are four elements which in general form the organic matter of plants; carbon, hydrogen, oxygen, and nitrogen, two or more of which united in variable proportions constitute an almost infinite number of proximate principles. Plants derive nourishment from the atmosphere and the soil. The former consists of carbon from carbonic acid, nitrogen from ammoniacal gas, and oxygen and hydrogen from watery vapour; and the latter consists of the same elements from decomposed organic matters and from water. Humus was formerly supposed to yield the principal aliment; but it is now known to be both an indirect and a quite secondary source.

Assimilation of Carbon.—Humus is soluble in an extremely minute degree in water, but when treated with alkalis, the humic acid formed is somewhat soluble. Suppose this acid to be absorbed in the form of that salt which is most soluble, the humate of lime, and suppose that potash, soda, the oxides of iron and manganese take up the same quantity of the acid as lime, Berthier found that 1,000 lbs. of dry fir-wood yielded 4 lbs. ashes, containing 53 per cent. metallic oxides. A Hessian acre yields annually 2,920 lbs. fir-wood, containing 6.17 lbs. metallic oxides. Then 1 lb. of lime, uniting with 12 lbs. humic acid, the 6.17 lbs. of the oxides would introduce 74 lbs. humic acid, which, containing 58 per cent. carbon, would correspond to 100 lbs. of wood; but the acre really yields 2,920 lbs. In the same way the oxides in wheat straw would produce 93.6 lbs. woody fibre to the acre, whereas the produce is 1,961 lbs. of straw composed similarly to woody fibre.

Calculating the quantity of this acid which plants might receive under the most favourable circumstances by the agency of rain-water, and supposing all the rain which falls on an acre to be received by the plants, and all to be saturated

by humate of lime, then the plants would receive only 330 lbs. humic acid, while the acre produces 2,843 lbs. of grain and straw, so that the 330 of acid would only account for a small quantity of the carbon actually obtained.

Again, the Hessian acre of wood or meadow yields 1,109 lbs. carbon in its wood or hay,—1,032 in the beetroot without the leaves, or 1,124 lbs. in straw and grain; equal surfaces of average fertility yielding equal quantities of carbon; and yet the conditions in the growth of these plants have been very dissimilar.

Moreover, the soil of meadow and forest, instead of losing carbon, actually increases its quantity, notwithstanding the removal of so much in the wood or hay, and the soil of a field which is manured contains no more than a meadow or forest which is not manured.

These considerations prove that the common view of the nutrition of plants by humic acid is incorrect. Whence, then, is their carbon derived?

The quantities of carbonic acid in the air averages 4 vols. in 10,000 vols., so that the weight of carbon which presses on an acre of land is about 7 tons. The quantity of oxygen estimated to be consumed by the respiration of 1,000,000,000 of men in one year is 0.79745 cubic miles. A town of 7,000 inhabitants consumes annually 551,000,000 cubic feet of oxygen in the combustion of wood. Hence we may conceive of the enormous quantity of carbonic acid constantly thrown into the air by the respiration of men and animals, by combustion, and the putrefaction of animal and vegetable matter. Now, analysis shows that the quantity of oxygen is the same now as it was 1,000 years since. There must be, therefore, some means of replacing the oxygen consumed, and of removing the carbonic acid which is formed.

Plants effect both of these changes, absorbing carbonic acid, decomposing it and giving off oxygen. A plant placed in water containing carbonic acid, and exposed to the sun's light, removes the acid and evolves oxygen, which may be collected in a receiver and examined; it increases in weight more than can be accounted for by the carbon taken up, which shows that the elements of water are assimilated at the same time. The quantity of carbon in the air may be shown to be 3,300 billions of lbs., which is more than all the plants and the strata of coal on the earth. Calculating from the quantity of carbonic acid absorbed by a freshly white-washed surface in a given time, a Hessian acre might absorb in 200 days 11.353 lbs. carbonic acid, containing 3,304 lbs. carbon, which is 3 times as much as obtained from plants growing on the same surface.

Carbonic acid is absorbed from the air by the leaves, and from the soil by the roots, for it forms an atmosphere in the soil around decaying humus. When exposed to sun-light it is decomposed while

oxygen is evolved, but at night this action ceases, and the acid is emitted while oxygen is absorbed. The emission of the acid is a simple mechanical process, the absorption of oxygen a chemical process, due to its action on the various organic substances in the flowers, fruits, &c., but neither have any thing to do with the process of assimilation. Thus volatile oils, tannin, &c., have a tendency to oxidize, and hence plants containing them absorb more oxygen than others; the tasteless leaves of the *Agave Americana* absorb 0.3 of their volume of oxygen in the dark during 24 hours, the leaves of the *Pinus abies* absorb 10 times, and those of the *Quercus robur* 14 times their volume.

These and other facts prove that the quantity of oxygen thrown into the atmosphere by plants, is greater than that which they receive from it.

To conclude, the carbon contained in plants is derived from the carbonic acid of the atmosphere, through the leaves or from that contained in the soil through the roots.

Origin and action of Humus.—All plants and vegetable structures undergo two processes of decomposition after death. One of these is named *fermentation*; the other, *putrefaction*, *decay*, or *eremacausis*.

The decay of woody fibre—the principal constituents of all plants—is accompanied by a phenomenon of a peculiar kind. This substance, in contact with air or oxygen gas, converts the latter into an equal volume of carbonic acid, and its decay ceases upon the disappearance of the oxygen. If the carbonic acid is removed, and oxygen replaced, its decay recommences, that is, it again converts oxygen into carbonic acid.

Woody fibre in a state of decay is the substance called *humus*. Its property of converting surrounding oxygen gas into carbonic acid diminishes in proportion as its decay advances, and at last a certain quantity of a brown coaly-looking substance remains, in which this property is entirely wanting. This substance is called *mould*; it is the product of the complete decay of woody fibre.

Humus is a continued source of carbonic acid, which it emits very slowly. An atmosphere of carbonic acid is therefore contained in every fertile soil, and is the first and most important food for the young plants which grow in it.

The roots perform the functions of the leaves from the first moment of their formation; they extract from the soil their proper nutriment, namely, the carbonic acid generated by the humus.

By loosening the soil which surrounds young plants, we favour the access of air, and the formation of carbonic acid, which is absorbed, and is replaced by atmospheric air, by which process the decay is renewed, and a fresh portion of carbonic acid formed. A plant at this time receives its food both by the roots and by the organs above ground, and advances rapidly to maturity.

When a plant has quite risen above ground, and when the organs by which it obtains food from the atmosphere are formed, the carbonic acid of the soil is no further required.

The power which roots possess of taking up nourishment does not cease as long as nutriment is present. When the food of a plant is in greater quantity than its organs require for their own perfect development, the superfluous nutriment is not returned to the soil, but is employed in the formation of new organs. At the side of a cell, already formed, another cell arises: at the side of a twig and leaf, a new twig and a new leaf are developed.

The functions of the leaves and other green parts of plants, to absorb carbonic acid, and with the aid of light and moisture, to appropriate its carbon, are continually in operation. But the new products arising from this continued assimilation are no longer employed by the perfect leaves in their own increase; they serve for the formation of woody fibre, and all the solid matters of similar composition. The leaves now produce sugar, amylin or starch, and acids, which were previously formed by the roots, when they were necessary for the development of the stem, buds, leaves, and branches of the plant.

The organs of assimilation, at this period of their life, receive more nourishment from the atmosphere than they employ in their own sustenance; and when the formation of the woody substance has advanced to a certain extent, the expenditure of the nutriment, the supply of which still remains the same, takes a new direction, and blossoms are produced. The functions of the leaves of most plants cease upon the ripening of their fruit, because the products of their action are no longer needed. They now yield to the chemical influence of the oxygen of the air, generally suffer a change in colour, and fall off.

A peculiar *transformation* of the matters contained in all plants takes place in the period between blossoming and the ripening of the fruit; new compounds are produced, which furnish constituents of the blossoms, fruit, and seed. An organic chemical transformation is the separation of the elements of one or several combinations, and their reunion into two or several others, which contain the same number of elements, either grouped in another manner, or in different proportions. Of two compounds formed in consequence of such a change, one remains as a component part of the blossom or fruit, while the other is separated by the roots in the form of excrementitious matter.

Hydrocyanic acid and water are decomposed by contact with muriatic acid into formic acid and ammonia; the muriatic seeking to be saturated by a base, selects the elements nitrogen and hydrogen to form ammonia, with which it unites, and its power of producing farther change is lost. By the separation of ammonia, the remaining elements unite to produce formic acid. The am-

monia represents the substance assimilated by the plant, and the formic acid the excrementitious matter.

By means of chemical transformations a great variety of products may now be obtained artificially, which, having been found in plants and animals, were supposed to result from the vital principle. The volatile oil of valerian may be obtained from the oil generated during the fermentation of potatoes; the oil of *Spiræa ulmaria* from the crystalline matter of the bark of the willow. We can form malic, oxalic, and formic acids, urea, &c.

Transformations of existing compounds are constantly taking place during the whole life of a plant, in consequence of which, and as the results of these transformations, there are produced gaseous matters which are excreted by the leaves and blossoms, solid excrements deposited in the bark, and fluid soluble substances which are eliminated by the roots. Substances containing a large proportion of carbon are excreted by the roots and absorbed by the soil. Through the expulsion of these matters unfitted for nutrition, the soil receives again with usury the carbon which it had at first yielded to the young plants as food, in the form of carbonic acid.

The soluble matter thus acquired by the soil is still capable of decay and putrefaction, and by undergoing these processes furnishes renewed sources of nutrition to another generation of plants; it becomes *humus*.

Humus does not nourish plants by being taken up and assimilated in its unaltered state, but by presenting a slow and lasting source of carbonic acid, which is absorbed by the roots, and is the principal nutriment of young plants at a time when, being destitute of leaves, they are unable to extract food from the atmosphere. "Many physiologists," says Mr. Shier, in the notes to his edition of Sir H. Davy's 'Elements of Agricultural Chemistry,' "maintain that plants derive a great part of their carbon from humous matter in the soil, and that they absorb it in solution in the form of humates of lime and ammonia. Liebig, while he admits that organic matter in the soil is useful in supplying carbon, denies that it is in the form of humates that it is taken up. Organic matter in soils to which air has access is continually undergoing decay, and carbonic acid thus formed constitutes the carbonaceous nutritive matter supplied by the soil. Liebig's principal arguments against the common theory may be thus condensed. 1st, The humic acid of chemists does not occur in appreciable quantity in fertile soils; it is formed in the course of the chemical processes had recourse to to procure it. If humates existed in the soil and constituted the food of plants, they would communicate a brown tint, and be readily detected in the water of springs, brooks, and rivers, but they are not so; neither do they occur in sea-water, hence, it must be from carbonic acid that the immense

crops of algæ that grow on the bottom and shores of the sea derive their carbon. 2d, The humates are so little soluble, that it can be shown, that all the rain that falls during the growth of common crops is incapable, even if it were all to be saturated with humates, and to pass through the plants, of affording a tithe of the carbon they require. 3d, There was no original humus, and hence it is not absolutely essential. 4th, Many plants have but a point of attachment in the soil, and live almost entirely by absorption from the air. 5th, Neither in cultivated land that is regularly manured, nor in forest and meadow lands that are not, does the humus decrease; in the latter cases, indeed, it increases. Boussingault shows in the case of the five-course rotation already referred to, that the carbon contained by the crops exceeded that contained by the manure, by 4745·5 kilogrammes per hectare = 4233·9 lbs. per imperial acre. The carbon, therefore, must, to this extent at least, have been derived from the air; and at the close of the rotation the humus had not decreased. Hence, it may be inferred, that the carbon derived from the organic matter in the soil was also taken up in the form of carbonic acid. Of recent attempts to settle the question by direct experiment, those of Saussure have attracted most attention. He endeavoured to show that soluble humates are taken up and assimilated by causing plants of the bean and polygonum to grow in a decoction of mould in bicarbonate of potash. Liebig has criticised these experiments, and shown, that they are inexact and inconclusive; and that the results are capable of a satisfactory explanation only on the principles they were intended to refute. On the whole then, it appears that there is no sufficient reason for holding that soluble humates form any appreciable or important part of the food of plants, however useful humus may be, both as a textural constituent of soils, and as affording carbonic acid by gradual decay."

Assimilation of Hydrogen.—We can conceive of the formation of wood by the decomposition of water; its hydrogen uniting with the elements of carbonic acid, and oxygen being eliminated. Thus 100 parts carbonic acid unite with 8·04 hydrogen, to form woody fibre, and separate 72·35 oxygen, which was combined with the hydrogen.

From their generating caoutchouc, wax, fats, and volatile oils containing hydrogen in large quantity, and no oxygen, we may be certain that plants possess the property of decomposing water, because from no other body could they obtain the hydrogen of those matters. It has also been proved by the observations of Humboldt on the fungi, that water may be decomposed without the assimilation of hydrogen. Water is a remarkable combination of two elements, which have the power to separate themselves from one another, in innumerable processes, in a manner imperceptible to our senses; while carbonic acid,

on the contrary, is only decomposable by violent chemical action.

All the hydrogen necessary for the formation of an organic compound is supplied to a plant by the decomposition of water. The process of assimilation, in its most simple form, consists in the extraction of hydrogen from water, and carbon from carbonic acid, in consequence of which, either all the oxygen of the water and carbonic acid is separated, as in the formation of caoutchouc, the volatile oils which contain no oxygen, and other similar substances, or only a part of it is exhaled.

The formation of acids is accompanied with the smallest separation of oxygen; the amount of oxygen set free increases with the production of the so-named neutral substances, and reaches its maximum in the formation of oils. Fruits remain acid in cold summers; while the most numerous trees under the tropics are those which produce oils, caoutchouc, and other substances containing very little oxygen.

Assimilation of Nitrogen.—There is no reason for believing that the nitrogen, contained in all parts of a vegetable structure, is derived from that gas in its free state, for, excepting in the case of ammonia, it cannot be made to unite directly with any element excepting oxygen. Ammonia is a compound of nitrogen and hydrogen, and the last product of the putrefaction of animal matters. It is capable of undergoing a multitude of transformations, in contact with other bodies, into the most various forms; either alone or with acids, it is very soluble in water; and hence it is the chief form in which nitrogen is conveyed to plants.

The thousands of millions of men and animals by death and decay yield a large quantity of ammonia, a portion of which must escape into the atmosphere; and the reason why it has not been previously detected is, that the quantity of air submitted to analysis is very small. Liebig proved its existence in pure rain-water by evaporation with muriatic acid; the sal ammoniac had always a brown or yellow colour, with the offensive odour of perspiration or animal excrements, from which its origin might be inferred. It has since been found by many others in rain-water, snow, and hail. If we suppose 1 lb. of rain to contain $\frac{1}{4}$ grain of ammonia, then 26,910 square feet (1 Hessian acre) must receive annually 88 lbs. of ammonia or 71 lbs. of nitrogen, which is more of the latter (in the form of vegetable albumen and gluten) than is contained in 2,920 lbs. wood, 3,085 lbs. hay or 10 tons beetroot (the produce of such an acre), but less than the grain, straw, and roots of grain, on the same surface.

Ammonia is evidently taken up by the roots of plants, and may be detected in many parts of their structure, in the juice of the maple tree, in the beetroot; it is obtained in the distillation of flowers, herbs, and roots, with water; the juice of the fresh tobacco leaf, and of the vine contains ammonia.

The quantity of gluten (a nitrogenous body) contained in grain, seems to increase with the quantity of ammonia arising from manures. Thus, wheat grown in a soil manured with cow-dung (containing a little nitrogen) yielded only 11.95 per cent. gluten, while in a soil manured with human urine it afforded 35.1 per cent. Putrefied urine contains a large proportion of nitrogen in the form of ammoniacal salts. Guano yields also much ammonia, and hence a part of its fertilizing effects.

Gypsum (plaster of Paris) acts beneficially by fixing ammonia in the soil and preventing its evaporation; for the sulphate of lime and carbonate of ammonia mutually decompose into sulphate of ammonia and carbonate of lime. The use of burned clay as manure and the fertility of ferruginous soils depend on the fixation of ammonia by alumina and sesquioxide of iron, with which it forms chemical compounds. Powdered charcoal absorbs 90 times its volume of ammonia, decayed wood 72 times (See ABSORPTION), and hence in part the use of humus.

The conclusion, then, is well established that the nitrogen of plants is derived from the ammonia of the atmosphere.

Inorganic constituents of Plants.—Plants absorb the soluble materials in a soil indiscriminately, retaining such as are necessary and returning the others as excrement. The various acids in plants are combined with potash, soda, lime, and magnesia, which regulate their formation, and when the plants are incinerated, these salts remain as carbonates. And since certain acids are peculiar to plants and essential to them, alkaline bases must be equally necessary. The capacity of saturation of these acids being uniform, the quantity of alkaline bases must be invariable.

The following analyses of ashes of two pine trees by De Saussure, and of two fir trees by Berthier, show that equivalent quantities of alkali are present.

<i>Pine from Mont Breven,</i>				
Carbonate of potash	3.80	contains of oxygen,		0.41
" lime	48.34	" "		7.33
" magnesia	6.77	" "		1.27
	58.71	Total oxygen		9.01

<i>Pine from Mont La Salle,</i>				
Carbonate of potash	7.36	contains of oxygen		0.85
" lime	51.19	" "		8.10
" magnesia	00.00	" "		
	58.55			8.95

<i>Fir from Allevard,</i>				
Potash }	16.8	contains of oxygen		3.42
Soda }		" "		
Lime	29.5	" "		6.20
Magnesia	3.2	" "		1.20
	49.5	Total oxygen		12.82

<i>Fir from Norveay,</i>				
Potash	14.1	contains of oxygen		2.4
Soda	20.7	" "		5.3
Lime	12.8	" "		3.45
Magnesia	4.35	" "		1.60
	51.85	Total oxygen		12.84

The quantity of oxygen is too nearly the same in the bases of the pines, although the bases vary, to suppose it accidental; and in the fir trees, after deducting the oxygen of the bases which were combined with phosphoric, sulphuric, and chlorohydric acids, the remainders are 11.62 and 11.47 respectively. Hence the quantities of oxygen being the same, equivalent quantities of bases are saturated although these vary materially.

"If potatoes are grown where they are not supplied with earth, the magazine of inorganic bases (in cellars for example) a true alkali, called solanin, of very poisonous nature, is formed in the sprouts which extend towards the light, while not the smallest trace of such a substance can be discovered in the roots, herbs, blossoms, or fruits of potatoes grown in fields.

"The conclusion to which all the foregoing facts lead us is, that the alkaline bases existing in the ashes of plants must be necessary to their growth, since if this were not the case they would not be retained.

"The perfect development of a plant according to this view, is dependent on the presence of alkalies or alkaline earths; for when these substances are totally wanting, its growth will be arrested, and when they are only deficient, it must be impeded."

Ten thousand parts of oak-wood yield 250 parts of ashes, the same quantity of fir-wood only 83, of linden-wood 500, of rye 440, and of the herb of the potato-plant, 1,500 parts.

Firs and pines find a sufficient quantity of alkalies in granitic and barren sandy soils in which oaks will not grow; and wheat thrives in soils favourable for the linden tree, because the bases which are necessary to bring it to complete maturity, exist there in sufficient quantity.

The Equisetaceæ and all the genera of grasses contain in the outer parts of their leaves and stalk a large quantity of silicic acid and potash in the form of acid silicate of potash. The proportion of this salt does not vary perceptibly in the soil of corn-fields, because it is again conveyed to them as manure in the form of putrefying straw. But this is not the case in a meadow, and hence we never find a luxuriant crop of grass on sandy and calcareous soils, which contain little potash, evidently because one of the constituents indispensable to the growth of the plants is wanting. Soils formed from basalt, greywacke, and porphyry, are, *cæteris paribus*, the best for meadow-land, on account of the quantity of potash which enters into their composition. The potash abstracted by the plants is restored under the annual irrigation.

A harvest of grain is obtained every 30 or 40 years from the soil of the Luneburg heath, by strewing it with the ashes of the heath-plants (*Erica vulgaris*) which grow on it. These plants during the long period just mentioned collect the potash and soda which are conveyed to them by

rain-water; and it is by means of these alkalies that oats, barley, and rye, to which they are indispensable, are enabled to grow on this sandy heath.

A proprietor of land in the vicinity of Göttingen, in order to obtain potash, planted his whole land with wormwood, the ashes of which are well known to contain a large proportion of the carbonate of that alkali. The consequence was, that he rendered his land quite incapable of bearing grain for many years, in consequence of having entirely deprived the soil of its potash.

The supposition that alkalies or inorganic matter in general are generated by plants is refuted by these facts. Steam and vapours have a remarkable power of transporting solid fixed matter, either in the form of a gas or dissolved in one.

It is known that in sea-storms, leaves of plants in the direction of the wind are covered with crystals of salt, even at the distance of from 20 to 30 miles from the sea. But it does not require a storm to cause the volatilization of the salt, for the air hanging over the sea always contains enough of this substance to make a solution of nitrate of silver turbid, and every breeze must carry this away. Now, as thousands of tons of sea-water annually evaporate into the atmosphere, a corresponding quantity of the salts dissolved in it, viz. of common salt, chloride of potassium, magnesia, and the remaining constituents of the sea-water, will be conveyed by the wind to the land.

By the continual evaporation of the sea, its salts are spread over the whole surface of the earth; and being subsequently carried down by the rain, furnish to the vegetation those salts necessary to its existence. This is the origin of the salts found in the ashes of plants, in those cases where the soil could not have yielded them.

Art of Culture.—Carbonic acid, ammonia, and water yield elements for all the organs of plants. Certain inorganic substances—salts and metallic oxides—serve peculiar functions in their organism, and many of them must be viewed as essential constituents of particular parts.

The atmosphere and the soil offer the same kind of nourishment to the leaves and roots. The former contains a comparatively inexhaustible supply of carbonic acid and ammonia; the latter, by means of its humus, generates constantly fresh carbonic acid, while, during the winter, rain and snow introduce into the soil a quantity of ammonia, sufficient for the development of the leaves and blossoms.

In whatever form we supply plants with those substances which are the products of their own action, in no instance do they appear to have any effect upon their growth, or to replace what they have lost. Sugar, gum, and starch, are not food for plants, and the same must be said of humic acid, which is so closely allied to them in composition.

The products generated by a plant may vary exceedingly, according to the substances given it as food. A superabundance of carbon in the state of carbonic acid conveyed through the roots of plants, without being accompanied by nitrogen, cannot be converted either into gluten, albumen, wood, or any other component part of an organ; but either it will be separated in the form of excrements, such as sugar, starch, oil, wax, resin, mannite, or gum, or those substances will be deposited in greater or less quantity in the wide cells and vessels.

The increase or diminution of the vital activity of the vegetables depends only on heat and solar light, which we have not arbitrarily at our disposal: all that we can do is to supply those substances which are adapted for assimilation by the power already present in the organs of the plant. But what then are these substances? They may easily be detected by the examination of a soil, which is always fertile in given cosmical and atmospheric conditions. Sand, clay, and lime are the names given to the principal constituents of the different kinds of soil. Pure sand and pure limestones, in which there are no other inorganic substances except siliceous earth, carbonate or silicate of lime, form absolutely barren soils. But argillaceous earths form always a part of fertile soils. There must, therefore, be something in aluminous earth which enables it to exercise an influence on the life of plants, and to assist in their development. The property on which this depends is that of its invariably containing potash and soda.

In order to form a distinct conception of the quantities of alkalies in aluminous minerals, it must be remembered that feldspar contains 17½ per cent. of potash, albite 11·43 per cent. of soda, and mica 3—5 per cent.; and that zeolite contains 13—16 per cent. of both alkalies taken together. The late analyses of Ch. Gmelin, Lowe, Fricke, Meyer, and Redtenbacher, have also shown, that basalt contains from ¾ to 3 per cent. of potash, and from 5—7 per cent. of soda, that clay-slate contains from 2·75—3·31 per cent. of potash, and loam from 1½—4 per cent. of potash.

If, now, we calculate from these data, and from the specific weights of the different substances, how much potash must be contained in a layer of soil, which has been formed by the disintegration of 26,910 square feet (1 Hessian acre) of one of these rocks to the depth of 20 inches, we find that a soil of

Felspar contains	...	...	1,269,000 lbs.
Clinkstone	...	from 220,400 to	440,000 ...
Basalt	...	52,300	82,600 ...
Clay-slate	...	110,000	220,400 ...
Loam	...	95,800	330,600 ...

Potash is present in all clays; according to Fuchs, it is contained even in marl; it has been found in all the argillaceous earths in which it has been sought.

Air, water, and the change of temperature pre-

pare the different species of rocks for yielding to plants the alkalies which they contain. A soil which has been exposed for centuries to all the influences which affect the disintegration of rocks, but from which the alkalies have not been removed, will be able to afford the means of nourishment to those vegetables which require alkalies for their growth during many years; but it must gradually become exhausted, unless those alkalies which have been removed are again replaced; a period, therefore, will arrive when it will be necessary to expose it from time to time to a further disintegration, in order to obtain a new supply of soluble alkalies.

The exhaustion of much of the soil in Lower Virginia by successive crops of wheat and tobacco during a long period of time, proves the necessity of alkalies for these plants, for in the space of a century 13,200 lbs. of alkalies per acre were removed in leaves, grain, and straw, and the land became unproductive. When the soil is thus exhausted it requires the lapse of time for the action of air, water, change of temperature, and carbonic acid, to decompose fresh portions of the rocky constituents of the soil, and set free more alkaline matter.

Potash is not the only substance necessary for the existence of most plants; indeed it has been already shown that the potash may be replaced in many cases by soda, magnesia, or lime; but other substances besides alkalies are required to sustain the life of plants.

Phosphoric acid has been found in the ashes of all plants hitherto examined, and always in combination with alkalies or alkaline earths. Most seeds contain certain quantities of phosphates. In the seeds of different kinds of corn particularly, there is abundance of phosphate of magnesia.

Plants obtain their phosphoric acid from the soil. It is a constituent of all land capable of cultivation, and even the heath at Luneburg contains it in appreciable quantity. Phosphoric acid has been detected also in all mineral waters in which its presence has been tested; and in those in which it has not been found, it has not been sought for.

It is evident that the seeds of corn could not be formed without the phosphate of magnesia, which is one of their invariable constituents; the plant could not under such circumstances reach maturity.

Some plants, however, extract other matters from the soil besides silica, potash, and phosphoric acid, which are essential constituents of the plants ordinarily cultivated. These other matters, we must suppose, supply, in part at least, the place and perform the functions of the substances just named. We may thus regard common salt, sulphate of potash, nitre, chloride of potassium, and other matters, as necessary constituents of several plants.

Clay-slate contains generally small quantities

of oxide of copper; and soils formed from micaeous schist contain some metallic fluorides. Now, small quantities of these substances also are absorbed into plants, although we cannot affirm that they are necessary to them.

De Saussure remarked that plants require unequal quantities of the component parts of soils in different stages of their development; an observation of much importance in considering the growth of plants. Thus, wheat yielded $\frac{79}{1000}$ of ashes a-month before blossoming, $\frac{54}{1000}$ while in blossom, and $\frac{33}{1000}$ after the ripening of the seeds. It is therefore evident that wheat, from the time of its flowering, restores a part of its organic constituents to the soil, although the phosphate of magnesia remains in the seeds. The fallow time is that period of culture during which land is exposed to a progressive disintegration by means of the influence of the atmosphere, for the purpose of rendering a certain quantity of alkalis capable of being appropriated by plants. It is evident, that the careful tilling of fallow-land must increase and accelerate this disintegration. Now many plants in the family of the *leguminosae* are remarkable on account of the small quantity of alkalis or salts in general which they contain. They belong to those which are termed fallow-crops, and the cause wherefore they do not exercise any injurious influence on corn which is cultivated immediately after them is, that they do not extract the alkalis of the soil, and only a very small quantity of phosphates.

Two plants growing beside each other will mutually injure one another, if they withdraw the same food from the soil. Hence it is not surprising that the wild chamomile (*Matricaria chamomilla*) and Scotch broom (*Spartium scoparium*) impede the growth of corn, when it is considered that both yield from 7 to 7.43 per cent. of ashes, which contain $\frac{6}{10}$ of carbonate of potash. Plants will, on the contrary, thrive beside each other, either when the substances necessary for their growth which they extract from the soil are of different kinds, or when they themselves are not both in the same stages of development at the same time.

On a soil, for example, which contains potash, both wheat and tobacco may be reared in succession, because the latter plant does not require phosphates, salts which are invariably present in wheat, but requires only alkalis, and food containing nitrogen. According to the analysis of Posselt and Reimann, 10,000 parts of the leaves of the tobacco-plant contain 16 parts of phosphate of lime, 8.8 parts of silica, and no magnesia; whilst an equal quantity of wheat straw contains 47.3 parts, and the same quantity of the grain of wheat 99.45 parts of phosphates. Now, if we suppose that the grain of wheat is equal to half the weight of its straw, then the quantity of phosphates extracted from a soil by the same weights of wheat and tobacco must be as 97.7:16. This difference is very considerable. The

roots of tobacco, as well as those of wheat, extract the phosphates contained in the soil, but they restore them again, because they are not essentially necessary to the development of the plant.

Alternation of Crops.—Experience has shown that the same crop cultivated on the same soil through successive years, deteriorates and will finally cease to yield profitably; that certain plants will thrive better after others, and that these last will then again become productive.

The experiments of Macaire-Princep prove that substances are excreted from the roots of plants, some of which he termed acrid and resinous, others mild like gum. The former he regarded as injurious, the latter nutritious. Hence the opinion that the same plant will not thrive in a soil where its excretions accumulate.

Decandolle supposes that plants absorb soluble matter of every kind from the soil, and thus receiving much matter unnecessary for nutrition, return it as excrement to the soil.

The excretion consists of two parts, that which is returned to the soil in an unaltered state and that arising from transformations which have taken place within the plant. The former, although useless to a particular plant, may be nutritive to another. The latter appears to change into humus by a more or less gradual change, and then yielding carbonic acid, forms the nutriment of young plants.

This artificial production of humus constitutes one advantage of the alternation of crops, and such plants are employed as excrete abundantly.

Another advantage lies in the different kinds of inorganic matter required by different plants. Thus two plants requiring the same, and grown successively on the same ground, gradually renders it incapable of producing them profitably; but where one follows another requiring different inorganic constituents, the decomposing action of atmospheric agents during the lapse of time prepares the soil again for the production of the first.

Manure.—We may regard organic and many inorganic substances as manures; but we find them varying much in their value both practically and by an analysis of their constituents. Thus the solid excrements of the cow and horse contain but little nitrogen, human faeces more; urine contains a large proportion. But the excrements of animals contain much silicate of potash and phosphates, human faeces the latter, while urine is rich both in nitrogenous matter and phosphates. Too much cannot be said on the employment of human excrements both liquid and solid, for while they constitute fertilizing manure of the highest value, they are usually rejected in British agriculture. See MANURE.

We have presented an outline of the newer views in agricultural chemistry, chiefly due to Liebig, whose essay we have followed and freely extracted from, not, however, from a conviction

of their truth in every respect; for we believe that, although he has adopted a true method in elevating agriculture and physiology by the application of chemical principles, he has by no means proved that carbonic acid, water, and ammonia constitute the sole source of the organic parts of plants. We therefore offer the opinions of others likewise grounded on experimental evidence.

VIEW OF THE THEORY THAT PLANTS DERIVE THEIR NUTRIMENT FROM ORGANIC AND INORGANIC MATTER.

Saussure has conducted some very able experiments which seem to prove that some plants do take up humus, not in the form of carbonic acid. He showed, contrary to the experiments of Hartig, that humus extracted from mould by alkali is absorbed by the roots; and that since a strongly coloured solution of humate of potassa becomes discoloured in the *Polygonum Persicaria*, while other colouring matters, such as ink, unfitted for nutrition, are not—that this humic material is assimilated. Without denying that carbonic acid and water are assimilated as nutritive matter, he holds humic extract is likewise useful to plants; that plants produced by the former alone are not as thrifty as with the use of mould. The following are his general conclusions:—

1. That fertile soil contains a mixture of soluble and insoluble organic matter; and that the introduction of the former by the roots into a plant is a powerful aid to that nutrition which is afforded by the atmosphere and water.

2. That the insoluble organic, greatly preponderating over the soluble, undergoes, by the assistance of water, slow fermentation, hence producing soluble nutritive matter.

3. That plants receive their nitrogen almost entirely by absorption of soluble organic matter.

4. That those coloured substances adapted to the nutrition of plants change colour, while those not nutritious enter a plant without undergoing decomposition.

Hermann has discovered that the chief part of the extractive matter in the juice of plants consists of similar constituents to humus, containing humic acids, crenic and apocrenic acids, and extractive humus. See HUMUS.

Mulder's experiments lead to the conclusion that, by the decay of vegetable substances, ulmin and ulmic acid are formed when the air is not freely admitted, and these again, by the action of the air, pass into humin and humic acid. His analyses of the humic acid in turf, decayed wood, and vegetable mould from various localities, prove that it is combined with ammonia, and the remarkable resemblance in the deduced formulæ, seems to prove conclusively that there is a class of humus bodies, which, although differing among each other, must be ranked together.

Mulder supposed this ammonia to have been abstracted as such from the air, but Hermann's experiments prove that during the decay of wood

1 volume of nitrogen and 2 vols. of oxygen are absorbed from the air, and 4 vols. carbonic acid given off, and that ammonia is a residual transformation.

These researches of Saussure, Mulder, and Hermann are certainly opposed to the views of Professor Liebig, and we may add to them the elaborate researches and conclusions of Boussingault and Payen. The following is the definition of powerful manures by the two last-named chemists:—Manure is the more valuable in proportion as the quantity of nitrogenous organic matter is greater than the non-nitrogenous organic matter; and in proportion as the decomposition of quaternary compounds acts gradually, and agrees with the progress of vegetation. They have therefore constructed a table showing the value of manures, that is, the quantity of nitrogen they contain. See MANURE.

Boussingault holds that plants receive a large proportion of nutriment from the air, but also receive no inconsiderable amount of organic material directly from the soil. He believes that the process of fallowing has chiefly the advantage of destroying weeds; that the system of rotation of crops does not depend on the injurious action of the excrements of plants, since Braconnot's experiments prove that such excrements are not produced, but it rather depends on the alternation of such plants as only extract nutrition from the soil, like the Gramineæ, and of such as take much nutriment from the air, like the Leguminosæ, and whose stubble ploughed under is in itself a good manure.

In conclusion, we may remark that Liebig has shown that a large proportion of the organic matter of plants is due to the assimilation of carbon from carbonic acid, but not that it is wholly due to this cause. He has not shown that their nitrogen is obtained chiefly from the ammonia of the atmosphere; while the formation of ammonia by the decomposition of animal manures, seems distinctly to indicate that one great source of nitrogen lies within the soil, a view strengthened by the experiments and inferences of Boussingault and Payen. Whether we adopt with the former the view that nitrogen is the measure of nutrition, we hold with him that the nitrogenous compounds in the soil are partly useful because of the more ready decomposition of compounds containing nitrogen, so that the carbon and hydrogen of such substances are more readily assimilated.

Again, Liebig censures the application of the principles of animal nutrition to vegetable physiology, and yet more than once draws such a comparison himself. It may be wrong to apply these principles in the same manner in both cases, but the principles themselves may hold good of both. Thus, while he has shown the importance of one constituent of the air, carbonic acid, another acts an equally important part to animals; for, without the action of the oxygen in producing internal transformations

and throwing off carbon, food cannot be regarded as nutriment. The oxygen of the air therefore serves in part for the nutrition of animals. While thus plants derive much nutrition from the air and a portion from the soil, animals derive much from the soil and a portion from the air. See farther under DECAY, EXCREMENT, GUANO, HUMUS, MANURE, PUTREFACTION, SOIL.

AGRICULTURAL EDUCATION. Special training for the skilful, scientific, and most profitable performance of the duties of a farmer. Not an art is practised by man which includes a greater variety of operations or involves a greater amount of scientific principles than farming; and yet almost every other art is popularly regarded as far more technical and intricate, and as requiring far higher qualifications, and a far more systematic and prolonged course of preparation for its successful performance. Popular opinion justly imposes a long apprenticeship upon every candidate for any department of mere handicraft, a long course of preparatory study upon every candidate for scientific or intellectual employment, and both an apprenticeship and a course of preparatory study upon every candidate for several of such professions as combine art and science; and yet, with marvellous inconsistency, it, in most instances, imposes no apprenticeship and no special study whatever upon the candidate for an employment far more noble and intricate than any handicraft, and eminently combining the influence of at least two-thirds of all the physical sciences, with the most varied manipulations of very complex art. How monstrous is it that, while one man is apprenticed seven years in order to make a shoe, another is not apprenticed at all in order to manage a farm,—that while one is required for many years to be both an apprentice and a student in order to make the contents of the British statute-book bear upon a case of litigation, another is not required to be either apprentice or student in order to make the experience of all countries and ages of the civilized world, and the principles and discoveries of some of the most profound and complex of human sciences, bear upon the diversified and multitudinous practices of agriculture! One year to a shoemaker's apprentice, and three years to a young lawyer, ought to be every particle as effective as seven years to a candidate for farming; and with not more than one or two exceptions, not an artificer, an artist, or a professional man exists, who requires more special training or a larger amount of technical knowledge than a farmer, or who possesses equal facilities to turn a liberal and munificent education to excellent practical account. Were the next generation of farmers all over the civilized world to be educated comparatively with other men in something like the proportions of their callings, human society would at one move experience almost as great a transition as when it passed from the degradation of the feudal ages to the dignity

of the nineteenth century. Even an old Roman author, amid the martial condition of a proud, vicious, and heathenish empire, had the sagacity to see the paramount importance of agricultural education, and the honesty to utter his astonishment at its neglect. "Nothing equals my surprise," says he, "when I consider that while those who desire to learn to speak well select an orator whose eloquence may serve them as a model; while those who are anxious to dance, or become good musicians, employ a dancing or a music master; in short, that while every one looks for the best master in order to make the best progress under his instructions, the most important science, next to that of wisdom, has neither pupils nor teachers. I have seen schools established for teaching rhetoric, geometry, music, dancing, &c., and yet I have never seen a master to teach agriculture, nor a pupil to learn it."

Actual farmers, who have had no special training may, in multitudes of instances, improve their knowledge and their general qualifications by free intercourse with persons better informed than themselves,—by accepting the advantages of example and instruction afforded on the home or model farms of many well-conducted estates,—by watching the proceedings, and receiving the assistance, of the agricultural societies of their country or province,—by attending any occasional or serial agricultural lectures which professional or scientific gentlemen may deliver in their vicinity,—and by making a diligent and discriminating use of one or more of the best books on agriculture. Thousands of the worst instructed classes of farmers—particularly such as the small peasant-farmers of Ireland—might, by the use of several of these means, or even of any one of them, speedily acquire such knowledge as would enable them to draw twenty or thirty per cent. of additional produce from their farms; not a few, also, of such farmers as have enjoyed a tolerably fair general education, but have not been taught to subordinate it fully to their profession, may turn any one or more of these means to eminent advantage; and even the small number of farmers who possess a fair acquaintance with all the principles of their art, and can assign a scientific reason for every practice and phenomenon on their farms, ought, for their neighbours' sakes, to give all such means their strongest sanction, and will scarcely fail to derive from them an important amount of benefit.

All descriptions of young persons training to be farmers require to spend a large portion of their time upon a farm, to observe with all possible frequency the practices of the farmery and the field, to take full and daily part in the operations of every season, and to learn, in a practical manner, the nature and conditions of every piece of labour, from the coarsest drudgery to the nicest and most artistic performance. Mere looking on, mere reading, mere listening, mere occasional acting, or all these four combined,

will far less enable a man to conduct a farm than even teach him to make a shoe or construct a steam engine. Pupil-farmers do not require, indeed, to become adepts in every agricultural practice,—they do not need to be the best workmen on the farm,—the ablest ploughmen, the most skilful sowers, the most expert manipulators of the stable and the barn; yet they certainly must acquire sufficient proficiency in every art and process, or at least sufficient practical acquaintance with the tact and methods of performing it, to be able to instruct others respecting it, and to judge when it is well and expertly done. They must fully labour, that they may understand the work; they must fully obey, that they may know how to command; they must take part in every thing, that they may learn to make judicious applications of the grand economical principle of the division of labour; they ought, in fact, to acquire the same comprehensive views of the operations of the farm as the farmer himself or the farmer's steward, and to share by turns in all the operations which these comprise. If the pupil naturally reside on a large, well-conditioned, and well-conducted farm, he of course cannot learn better than where he is; if he reside on a stock-farm, or small and ill-conditioned arable farm, he ought, if possible, to be placed, during two years, on a farm of superior character; and if he reside, in either town or country, with parents or guardians who are not farmers, he ought to be apprenticed for three or more years with a skilful, scientific, extensive, upright farmer, who shall agree to treat him as if he were his son.

Yet mere practical learning—as we have already hinted—will as completely fail to make a man a wise farmer as mere theory. The pupil, by carefully imitating all around him, may become a very expert monkey; but, unless he learn a reason for every operation, he will never farm like a rational being. His business, in preparing to become a farmer, is to learn the science of agriculture as truly as the art,—the principles of it as thoroughly as the practices. He ought, therefore, during the whole course of his practical instruction on the farm, to be receiving explanations of the phenomena which he witnesses and the practices in which he shares,—to be soliciting information respecting every matter which he does not clearly understand,—and to be exercising his judgment as to the fittest mode of performing operations, the likeliest mode of overcoming difficulties, and the most feasible mode of attempting improvements. When he is under the care of a father or a kind master who farms intelligently, and possesses a fair share of science, he ought to acquire from him a large amount of the requisite intellectual instruction; yet, even in this case—and unspeakably more if he be under the care of a mere imitative farmer—he requires the aid of such stores of knowledge as can be obtained only from other sources and by separate study. He needs, in fact, to be

scientifically trained with books and by a school-master, not less than to be practically trained with implements and by the farmer.

Whatever any ordinary school can furnish, in the departments of English education, writing, arithmetic, book-keeping, and elementary mathematics, ought, as a matter of course, to be acquired by every son of a farmer, and by every other boy who is likely to become an agriculturist; and till more suitable institutions shall be called into existence, select academies, schools of art, mechanics' institutions, occasional series of lectures, private courses of scientific lectures in cities, and the public lectures in universities,—or, in the absence of all these, public libraries and private copies of select books,—must be looked to as the grand sources of all the other requisite departments of information. Four general topics—chemistry, veterinary surgery, natural history, and natural philosophy—comprise the whole circle of those sciences which the agricultural pupil requires to study; and though two of them include the numerous and important subdivisions of geology, mineralogy, botany, vegetable physiology, zoology, anatomy, meteorology, electricity, magnetism, pneumatics, dynamics, and mechanics, yet all may be competently studied in themselves, and sufficiently understood in their adaptations to agriculture, in the course of three years' attendance at such seats of learning as Edinburgh, London, Dublin, Glasgow, Aberdeen, or Belfast,—or in the course of four years sedulous and judicious use of the best public appliances which the nearest considerable town affords, combined with copious reading and reflection. The whole time consumed in the professional training of a young farmer, would thus be three years on the farm and three at a seat of learning; and surely, when we consider the great comparative importance of his vocation, and the vast power which he acquires from knowledge to render that vocation productive to himself and to society, this amount of time cannot but be pronounced economically small. Whatever comfortable farmer grudges his son so moderate a quantum of professional education, deserves, in punishment of his parsimony, to be constantly worried with the attacks of vermin and the blunders of boors. We must not be understood, however, as saying either that the three years of practical education are all to be spent in sheer labour on the farm, or that the three years of scientific education are all to be spent in sheer study at a seat of learning, or that the topics and appliances which we have named are the only ones worthy of the pupil's attention. The more the practical part of the training is intermixed with science, the sooner and better will the principles of it be understood; the more the scientific part of it is interspersed with periods of recess from the seat of learning and of labour on the farm, the more freely will its acquisitions adapt themselves to both present and permanent utility; and the more liberally

the pupil can look into collateral topics, such as *materia medica*, or avail himself of directly professional aids, such as the regular lectures on agriculture in the universities of Edinburgh and Aberdeen, the more fully and effectively will he work out the grand designs of all his educational training. See AGRICULTURAL SCHOOLS.

AGRICULTURAL LABOURERS. See FARM SERVANTS.

AGRICULTURAL LITERATURE. The aggregate of published writings on the subject of agriculture. The amount of this is enormous. But one great portion of it is obsolete; another great portion is vapid, unreflecting, worrying repetition of what everybody knows; and a third great portion is mere theory and speculation,—either the monomania of practical improvers, or the wild day-dream of utopian philosophers. Yet it comprises numerous works of high value, and several series of periodicals of not a little excellence; and though it can boast but few and brief specimens of beauty or eloquence, it possesses a fair share of the far more valuable properties of sound learning and useful tendency. A view of its ancient and progressive condition is included in the historical section of our General Introduction; and a *vidimus* of its best works on all the subjects most interesting to the farmer, is afforded by our lists of authorities at the end of all our principal articles.

AGRICULTURAL SCHOOLS. Institutions for training young men in both the art and the science of agriculture. In the degree in which any of them are so constituted and conducted as to make their pupils at once thorough practical farmers and complete or even tolerable scientific agriculturists, they serve precisely the great purposes which we have desiderated and recommended on the subject of AGRICULTURAL EDUCATION. But some of them are too superficial, others are not sufficiently practical, and most or all are too stiff, too formal, too academical, too little possessed of the actual, business, every-day character of both the working and the thinking of real agriculture; and hence some are more likely to produce pedants and pretenders than true scientific farmers,—and the best seem adapted rather to educate gentlemen's sons for practising an intelligent supervision of their estates, than to train young men of the middle classes of society for an effective performance of the thousand hard duties of practical farming. Yet several of them possess great excellencies; and all the principal ones deserve to be made as fully known as possible, both for their own sakes, and that they may stimulate and direct the founding of better institutions.

The institute of agriculture and forestry, at Hohenheim, near Stuttgart, was founded by the celebrated Schwartz, and placed on its present basis in 1817 by the King of Wurtemberg, and extends its influence over the whole of that state, and into parts of the adjoining countries. It was endowed by the king with a royal seat and ex-

tensive buildings; it has attached to its school-rooms and lodging-houses, farming and other grounds to the extent of 960 acres; and it possesses, for the use of pupils, a museum, a library, a small laboratory, a collection of apparatus, a cider-press, a vinegar-manufactory, a beet-sugar manufactory, a brewery, a distillery, and various other appliances. Its grounds are divided into about 501 acres of arable land, 242 acres of meadow land, 13 acres of woodland, 67 acres of nursery ground, 2 acres of hop plantation, 14 acres of botanical garden, 1 acre of kitchen and flower garden, 33 acres of experimental ground, and 85 acres of reserve ground. The institution is divided into two departments,—the lower, devoted chiefly to practical training,—and the higher, intended principally for scientific instruction. In the lower school, natives of Wurtemberg, who cannot pay, are admitted gratis; in the higher school, all pupils are expected to pay; and to either school, but on a higher scale, foreigners may be admitted. Pupils are not admissible till the age of seventeen; and are expected to have previously acquired all elementary attainments. The number of pupils in the lower school is limited to 27; that in the higher school in 1836 was 72; and the total number in both departments from 1829 to 1836 was 539. The pupils in the lower school usually engage to remain three years; they take part in all the operations of the farm, the garden, and the other scenes of labour; they receive some instructions during the intervals of labour, and attend some of the lectures delivered to the pupils of the higher school; and they generally receive wages for their work, and make payments out of these for their maintenance and clothing. The pupils of the higher school, if previously well trained, attend only one year, but, in general, they attend during two years; those enrolled for the school of forestry also attend during two years; so that all who enjoy a full course attend during four years or eight sessions,—each year consisting of two long sessions and two short vacations,—the sessions extending from the first of November to Palm Sunday, and from two weeks after Palm Sunday to the first of October. The topics of instruction during the first year are the general principles of farming and gardening, the culture of the vine, the breeding of cattle, the growing of wool, the training of horses, the rearing of silk-worms, the arranging and directing of farms, the valuing of farms, and book-keeping; during the second year, the general principles of forestry, the botany of forests, the culture and superintendence of forests, the uses of forests, the technology of forests, and the laws and taxation affecting forests; during the third year, veterinary surgery, agricultural technology, the manufacture of beet-sugar, brewing, distilling, vinegar-making, zoology, *materia medica*, chemistry, meteorology, and vegetable physiology; and during the fourth year, theoretical and practical mathematics, or geometry, trig-

onometry, algebra, and arithmetic. The practical department of the institution, or that belonging to the lower school, appears to be far more desirably conducted than the scientific; and while the higher school has probably produced a race of agricultural pedants, and can hardly fail to imbue its pupils with the monstrous error of substituting mere science and speculation for effective knowledge, the lower school, even in spite of serious defect in theoretic instruction, seems to have exerted a highly advantageous influence upon the agricultural condition of most of Wurtemberg. "The pupils of the lower school," we are told, "rise to their work in summer at three o'clock, when they commence to feed and clean the cattle, groom the horses, remove the litter, &c., until about five o'clock; they then breakfast, and at half-past five take their station in the yard, whence they issue forth in a quiet and orderly but lively manner to their respective employments, under the direction of the superintendent, with their teams of 24 oxen and 10 horses. At eleven, there is a cessation of work, during half-an-hour for dinner; then succeeds the feeding of the cattle, and a new distribution of employments; and work continues until seven. After supper, lessons are given; in winter, school instruction is also afforded in the course of the day. The beneficial results of this system are widely diffused through Wurtemberg; and the peasantry are everywhere found an enlightened class, always ready to give a clear and ready answer to any questions proposed regarding their agricultural practice."

The celebrated institution of M. de Fellenberg at Hofwyl, in the canton of Berne in Switzerland, combines the various objects of a moral, scientific, and general education, and subordinates them partly to the purposes of general industry, and in a main degree to the pursuits of agriculture. It comprises extensive buildings for instruction and residence; a farm of 170 or 250 acres, for experimental and industrial labour in farming; facilities and appliances for instruction and experiment in various departments of handicraft; and an exceedingly numerous corps of tutors and professors, so selected, qualified, and classified as to communicate all the details of instruction by the easy and agreeable method of mere oral teaching. All the pupils remain during nine years, or till they attain the age of twenty-one; and all undergo constant training in habits of industry, frugality, docility, veracity, mutual kindness, and general morality. But they are divided into two great classes,—the higher, or boys who anticipate the spending of their life in affluence,—and the lower, or boys who anticipate the necessity of self-support throughout a lifetime of active labour. Pupils of the higher class pay rather handsomely for their education,—especially if they are not natives of the canton of Berne; and during the first three years, they are taught the Greek language, Grecian history, and the sciences of

mineralogy, botany, and zoology; during the second three years, the Latin language, Roman history, and the geography of the Roman empire; during the last three years, modern languages, modern literature, modern history, general geography, chemistry, and natural philosophy; and during the whole nine years, mathematics, drawing, music, and gymnastic exercises. The lower class of pupils are distributed into three divisions according to their age and strength; and they spend the whole of their time in working, learning, and making progress in the acquisition of healthy and useful habits. The pupils of the first division receive half-an-hour's instruction in the morning, then breakfast, then work on the farm till noon, then spend an hour at dinner, then receive an hour's instruction, and then work on the farm till six o'clock in the evening; and, during the wintry portion of the year when farm labours are few and brief, they plait straw and rushes, make baskets, saw and split timber, knit stockings, grind colours, and thrash and winnow corn; and any of the lower class whatever who have a wish to acquire a knowledge of artificership, receive practical instructions in the crafts of the shoemaker, the tailor, the smith, the wheelwright, or the carpenter. Each pupil of the lower class, on the average, contributes to the establishment in labour and otherwise to the value of between £59 and £60; and he costs, for maintenance, instruction, and all other items, about £56. The pupils of the higher class, on completing their course, are usually found to be well conducted and very intelligent; and those of the lower class, to be as well behaved, as temperate, and as hardworking as the choicest of the general body of the peasantry, and far superior to them in agricultural skill, artificer's tact, practical wisdom, and many departments of useful and general knowledge. The school-rooms, the extensive accommodations, and the numerous staff of tutors for the higher class of pupils, and the farm, the workshops, and the practical instructors for the lower class, constitute two grand departments of educational mechanism which possess fine coherence, afford a large amount of mutual support, and lay deep foundations for the reciprocal working, throughout life, of the principles respectively of landlord and tenant, or of gentleman and artificer. "The farm," says a writer in the 'Edinburgh Review,' "is undoubtedly benefited by the institution, which affords a ready market for its produce, and perhaps by the low price at which the labour of the boys is charged. But the farm, on the other hand, affords regular employment to the boys, and also enables M. de Fellenberg to receive his richer pupils at a lower price than he could otherwise do. Hofwyl, in short, is a great whole, where 120 or 130 pupils, more than 50 masters and professors, as many servants, and a number of day-labourers, 6 or 8 families of artificers and tradesmen, altogether about 300 persons, find a plentiful and, in many respects, a luxurious sub-

sistence, exclusive of education, out of a produce of 170 acres; and a money income of £6,000 or £7,000, reduced more than half by salaries, affords a very considerable surplus to lay out in additional buildings."

The far-famed German agricultural college of Möeglin, is situated near Frankfort on the Oder. It was founded about thirty-two years ago by the King of Prussia; placed under the direction of M. Von Thäer; and constituted a royal academy, with a staff of professors, who should have the same rank as the professors of a university. An estate of 1,200 English acres was attached to it,—chiefly poor land, and yielding an annual rental of only about £300; and, in the course of not more than 10 or 11 years, this estate became so greatly improved as to be worth an annual rental of £1,800. M. Von Thäer, the first president and professor, was a gentleman of much agricultural and scientific celebrity, and was intrusted with the high duty of appointing the other professors; and his son, M. Von Thäer, the second president, has acquired a higher fame than even the father, is favourably known in literature as the author of a work entitled 'Rational Principles of Husbandry,' and has conducted the college of Möeglin up to a very eminent status of both character and influence. Pupils admitted to the institution require to have spent five or six years in the practices and manipulations of husbandry, and are supposed to be in quest principally of scientific instruction; they board at the same table with the president, and have their dormitories within the buildings of the college; and they receive from the president daily general directions and weekly lessons in rural economy, and from the professors prelectional instructions in the various departments of agricultural science. One professor lectures to them on mathematics, chemistry, and geology; another, on veterinary surgery; a third, on zoology, botany, and the materia medica; and a fourth gives them instructions how to apply their various scientific acquisitions to the purposes of practical husbandry. Much aid is afforded by a laboratory for analyzing soils and for other chemical operations; a large botanic garden, for explaining the prelections in botany; a museum of implements, for illustrating the operations of tillage; and a set of workshops for the fabrication, by well-qualified artificers, and with the assistance of the pupils, of all the articles of carpentry and smith-work required on the farm. The pupils are from 20 to 24 years of age, and pay such fees as only gentlemen or persons in decidedly easy circumstances can afford.

The French agricultural college of Grignon, in the valley of Gally, near Versailles, was founded in 1826, and brought into organized operation in 1829. One half of the sum of £25,000, raised in shares by a joint-stock company of learned and patriotic men, was devoted to the general advancement of the cause of agriculture, and the other half to the establishment of two agricul-

tural schools,—the one a college for the thorough education of gentlemen-farmers, and the other a seminary for the superior training of gardeners, ploughmen; shepherds, and other agricultural labourers. The joint-stock company purchased the demesne of Grignon, and placed it under the management of M. Bella, one of the ablest pupils of M. Von Thäer; and Charles X. attached to it his adjoining demesne, gave the company the title of the 'Royal Agricultural Society,' and incorporated or formally sanctioned it by a royal ordinance. The lands of the institution comprise 1,100 acres,—variously disposed in tillage, pasture, meadow, water-meadow, and woodland. The pupils consist of two great classes, internal and external: the first board and lodge within the college buildings, and pay each from £30 to £60 a-year; and the second find board and lodging for themselves, and pay for their instruction from £8 to £20 a-year. Every pupil must attend during at least two years; and at the end of that period, he undergoes examination, and, if found duly qualified, receives a diploma as a sort of master of arts in agriculture. The topics of instruction during the first year, are mathematics, geography, chemistry, natural philosophy, botany, vegetable physiology, book-keeping, and farm-management; and during the second year, the application of science to practical agriculture, the application of mathematics to mechanics and astronomy, the application of chemistry to analysis, the application of natural philosophy to farming economics, the subordination of mineralogy and geology to georgical improvement, gardening, rural architecture, and the farmer's department of political economy. The best agricultural implements invented in Great Britain and Germany, and the newest methods of agricultural practice adopted or recommended in these countries, are put to the trial at Grignon, with a view to their being condemned or sanctioned according to their merits.

Numerous model farms exist in France, altogether distinct from the great national one at Grignon; and some of these are maintained by private enterprise, but most are supported wholly or principally at the expense of the territorial department in which they are situated. The earliest of them was the model farm of Roville, situated in the vicinity of Nancy, and founded by M. Mathieu de Dombasle; but this, though confessedly a source of extensive benefit to the kingdom, has been mainly useful in stimulating the formation of other institutions, particularly the college of Grignon. Some of the departmental model farms are quite insignificant; but others are considerable in both extent and efficiency. A favourable specimen of the latter, situated near Rennes, was visited by the well-known Irish agriculturist and patriot, Martin Doyle, and is reported on by him as follows:—"The farm consists of 72 acres of arable land held by lease of 15 years from a wealthy proprietor, by M. Bodin, who was

assisted by the principal authorities of the department of Ile et Vilaine to take the direction of it. M. Bodin had been a pupil at Grignon, and subsequently managed a small farm in a similar capacity, before he obtained the present one, which was in 1837. The rent of the farm is 3,500 francs (£140), of which the department pays 2,000 francs, and the director the remainder, with taxes and repairs, which amount to about 500 francs more. He also supplies all capital for improvements and all outgoings, clears all losses, and of course has all the profits. There are in this school 20 pupils, paying £12 a-year each; the department in which the school is situated, pays for six, and the government pays for the remaining fourteen, who are nominated by the prefects of three other departments in Brittany. In case of dismissals for misconduct, the prefects nominate other pupils, and they are unwilling to select youth from the towns, or any not accustomed to field labour; they are generally the sons of well-conducted farmers, and, at the expiration of two years, go to the aid of their parents, or as hired stewards. They are taught by M. Bodin, or an assistant, the ordinary subjects suited to their employment, and have no charge except for books, which they must supply for themselves. They rise in winter at four o'clock, and in summer at five, and work six hours each day (more in busy seasons), having the remainder of the day for meals and instruction in schools. They have also ten days holidays in spring, and a month in autumn by sections, as a sufficient number must be retained for the farm-work. M. Bodin has a factory for implements, and disposes of many of them to farmers, even in very distant localities."

Three sheep farms, entirely supported by the French government, exist at Rombouillet, Perpignan, and La Hayevaux. They are devoted to the rearing of the best breeds of sheep, and to the conducting of experiments in crossing. The principal breeds to which they had attended, up to 1840, were the merino, the naz, and the English long-wool. The number of sheep, in 1839, on the Rombouillet farm was 715, on the Perpignan farm 504, and on the La Hayevaux farm 312. The aggregate flock of the English breed amounted to 320; and these were proposed to be removed to some place near Calais or in Normandy, in order that they might enjoy a climate as nearly as possible resembling that of England.—Three veterinary schools, wholly supported by the French government, exist at Lyons, at Toulouse, and at a place in the vicinity of Paris. The course of education in these schools extends through four years, and includes not only veterinary surgery, but anatomy, botany, and chemistry. Dissecting rooms exist for the illustration of anatomy; botanic gardens, for the explanation of botany; and an hospital of invalid horses, for the practice of veterinary surgery. The pupils undergo searching examination; all who are qualified receive diplomas; and some obtain

government appointments. The number of students at the school in the vicinity of Paris, in 1839, was 280; and each was lodged, boarded, and instructed for £14 a-year.—Three haras or studs, wholly supported by the French government, and designed to offer their advantages to all the French public, exist at Du Pin, Rozieres, and Pompadour. The hara at Du Pin, in Normandy, is the largest of the three, promotes the diffusion of the best English breeds of horses, and was proposed, four or five years ago, to have attached to it an establishment for the diffusion of the Durham short-horn breed of horned cattle. The hara at Rozieres is devoted principally to a mixed breed, called the *Race ducale*, which has long been established in the neighbourhood. The hara at Pompadour has 40 Arab mares, and a great many Arab horses, and is devoted almost solely to the Arabian and Persian breeds. In 1839, the total number of horses in the three haras was 1,300,—of thorough-bred stock, 167 stallions, 98 mares, and 121 colts and fillies,—of covering stallions for the departments 870, annually serving on the average 30,450 mares.—The French government, besides supporting these various institutions, the departmental model farms, and the great national model farm at Grignon, disseminates agricultural information, and promotes agricultural improvement, by experiments, by lectures, by district societies, and by local associations. The government grant to each society is about £40 a-year, and to each association from £8 to £20. In 1824, the number of societies was 17, and of associations 41; and, in 1839, the number of societies was 154, and of associations 468. The total annual cost of the public agricultural establishments of France to government, amounted in 1839 to £119,452.

Two institutions in other parts of Switzerland have been founded on the model of that of M. De Fellenberg at Hofwyl,—both connected with convents,—the one in the canton of Fribourg, and the other in the canton of Thurgovie. An institution for training persons to become masters of industrial and agricultural schools for poor orphans, framed somewhat on the model of the institution of M. De Fellenberg, and conducted by a former zealous and faithful assistant of that gentleman, was founded by the municipality of Constance. An agricultural college, under the immediate patronage of the Emperor, has existed for some time in Russia; and agricultural schools, for combining instruction in the science of agriculture, with training in its practice, are in operation at St. Petersburg and Moscow. An agricultural institution, belonging to M. Voght, is in operation at Flottbeck in Flanders.

Very many of the ordinary farms of the north of Germany may be regarded as, in point of fact, a low yet efficient species of agricultural schools. Many peasant lads of 16 or 17 years of age bind themselves during three years to farmers, to serve in the double capacity of pupils and apprentices,

to pay for their maintenance, and to take part in all the successive labours of a regular course of husbandry, from the care of cattle and the work of the farm-yard, to the management of the plough, the hand-sowing of seed, and the keeping of farm-accounts. At the expiration of his apprenticeship, a pupil engages himself, during two years, to serve on some larger farm, as second verwalter or under-bailiff; and at the end of these two years, he either may find a situation as first verwalter or farm-steward, or may enter an agricultural institution to qualify him for the tenancy of one of the royal farms,* or for the management of the farm or estate of an absentee proprietor. "A system of long and laborious educational discipline among the peasantry such as this," remarks Mr. Martin Doyle, "would necessarily produce good results in Ireland, where husbandry is so generally defective. The advantages of having a great supply of good operative husbandmen, to meet the demands which both the theoretical and practical diffusion of improved agriculture among the higher classes of farmers must necessarily create, would considerably aid all the progress of improvement with mutual benefit to the employers and the employed." But the system of farm-apprenticeship which prevails on some of the great practical farms of England totally differs from the farm-apprenticeship of Germany, and has for its object, far less any real instruction in agriculture, than the working out of a decent pretext for ignorant, frivolous, fox-hunting young gentlemen taking the nominal management of farms or estates. A fop, a fashionable idler, or any sort of young gentleman who has no better prospect of worldly promotion than to become a gentleman-farmer, and who scarcely knows a dock from a bean-stalk, or a grubber from a wheel-barrow, pays £100 or £200 a-year of apprentice-fee to an extensive and distinguished farmer, stares occasionally at the operations of the farm-servants, learns the names of two or three crops and half-a-dozen implements, and, possibly at the end of a single year, is pronounced by himself and his partial friends sufficiently qualified to superintend the business of a farm. Training like this—if training it can be called—is sheer derision upon farm-apprenticeship, and a monstrous insult upon agriculture.

In 1839, resolutions were adopted by meetings of influential gentlemen at Maidstone to frame and mature a scheme for a Kent agricultural college, and to adopt and prosecute measures for obtaining such an amount of subscriptions as would be requisite for its establishment. In 1840, a scheme was published for establishing an agricultural college and a model farm in Yorkshire; and this scheme proposed that the capital for the institution should amount to from £6,000 to £10,000, and should be raised in £10 shares,

* Each royal farm is let on a lease of twenty-one years; but, to a correct and skilful tenant, is nearly a perpetuity.

—that the supreme management should be vested in a fluctuating board of twenty-one proprietors, elected by the shareholders,—that the college should be conducted by a professor of agriculture and assistant-masters,—that the subjects of the lectures in the college should be agriculture, geology, botany, chemistry, mechanics, and veterinary surgery,—that the students at the college should, in company with the professor of agriculture, attend the farm, and receive practical instructions there, during six hours of each of three days in the week,—that the farm should be conducted by a master, a matron, a farm-steward, and a dairy-maid,—that pupils on the farm devoting their main attention to the acquisition of practical knowledge, should be permitted to attend some of the lectures at the college,—and that the farm should be managed with direct subordination to the market-profits of its produce, yet should be available for all experiments proposed by the Royal and Yorkshire agricultural societies, provided that, in the event of loss, indemnification should be made from the societies' funds.

An agricultural school was founded in 1821, at Bannow, in the county of Wexford; but, in consequence chiefly of the pupils paying only a nominal sum for their maintenance, and being in general too young to perform a fair amount of productive labour, it was kept in operation during only seven years. Its farm was a rent-free tract of 40 acres, poor in soil, and naturally unproductive; its instructional management was conducted by an able superintendent and two masters; and its course of education included reading, writing, arithmetic, mensuration, surveying, geometry, mechanics, agricultural chemistry, practical farming, and horticulture.—An agricultural school was founded, in 1827, at Templemoyle, five miles east-north-east of the city of Londonderry. The members of the North-west of Ireland Society, with whom the plan of the school originated, contributed, in shares of £25 each, about £3,000 towards its establishment; and other parties, chiefly the Grocers' Company, on whose estate it is situated, contributed about £1,000. The institution is supported by fees of £10 a-year for each pupil, by the produce of labour and cropping on its farm, and by contributions from the Irish Society, and from the Grocers', Drapers', Fishmongers', Mercers', and Cloth-workers' Companies. The farm comprises 172 acres, and is managed by a steward, a ploughman, and a gardener; the buildings are extensive and commodious, and include the principal dormitories, each 40 feet long, 21½ wide, and 13 high; and its instructional course is conducted by two masters, and comprises a wide sphere of both elementary and general education. The business of instruction in the school alternates with that of labour on the farm; yet it is neither sufficiently comprehensive to make the pupils scientific farmers, nor so strictly professional as to be unadapted to

avocations which have little or no connexion with agriculture. The total number of pupils in the institution from its commencement till August 1841 was 418; and out of these, as well as of any others who left it previous to September 1843, so many as 93 emigrated to the colonies, 13 became shopkeepers, 11 became clerks, some became schoolmasters or land-surveyors, and only a little more than two-thirds of the whole devoted themselves to domestic farming,—36 as farm-stewards, and the remainder as farmers or farm-servants. Yet the Templemoyle institution has evidently achieved great good; and last year it experienced a considerable increase to its prosperity, and was about to receive an accession to its buildings.—Several other schools in Ireland partake of an agricultural character, and one or two have commenced with considerable pretensions; but they are either practical failures, or of meagre character and influence.

The professorship of agriculture in the University of Edinburgh was founded in 1790, by Sir William Pulteney. The first professor, Dr. Coventry, occupied the chair from 1791 till his death in 1831. His early classes consisted of upwards of 70 pupils; his subsequent classes consisted of 30 or 40 pupils; and his later classes diminished almost to extinction, and were held only on alternate years. Mr. Low, the next professor, enjoyed important aid from the Board of Trustees for the encouragement of arts and manufactures in Scotland; formed a valuable museum of models, portraits, and other articles, for illustrating his lectures; and made an important contribution to agricultural literature in 1834 by the publication of his 'Practical Elements of Agriculture.'—A lectureship of agriculture was a year or two ago appointed in Marischal college, Aberdeen; but the appointment was understood to be a mere experiment, and was made for only three years, and upon an annual salary of only £40.—An endowment is said to exist for a professorship of agriculture in one of the colleges of Oxford.—The Veterinary college of London was founded in 1791, and is supported by yearly subscriptions, and occasional parliamentary grants. The business of the college, till quite recently, was devoted chiefly to the diseases of the horse; but, in virtue of a grant of £300 a-year from the Royal Agricultural Society of England, it now comprises attention to the diseases of the other animals reared or kept on farms.—The Veterinary college of Edinburgh originated in the personal enterprise of its first and talented professor, Mr. William Dick. From 1818 to 1823, that gentleman laboured gratuitously for the diffusion of veterinary science; in 1823, he obtained formal sanction and a small salary from the Highland and Agricultural Society of Scotland; and during subsequent years he raised the college to so great an elevation as to be annually attended by from 70 to 100 pupils. Students at the Veterinary college are admitted gratis to the lectures on

human anatomy and physiology in Queen's college; and, after attending both colleges, or at least the former, during two or more years, they are examinable for a diploma in veterinary surgery.

AGRICULTURAL SEEDS. The seeds of crops grown on farms. Though, as usually understood, these seeds are strictly such as are used in farm-culture, and are exclusive of all seeds of trees, shrubs, garden-plants, medical plants, and weeds, yet they are far too numerous to be here defined or even enumerated. The number of botanical species grown upon a farm, indeed, is not very considerable; but the number of varieties of some of these species—particularly of the grains and the leguminous plants—is almost incredible. An excellent manual of all the best and most curious varieties of nearly all the species—containing not merely an enumeration, but definitions, historical notices, and practical hints—is Mr. Charles Lawson's 'Agriculturist's Manual, or Familiar Description of the agricultural plants cultivated in Europe, especially those suited to the climate of Great Britain, forming a report of Lawson's agricultural museum in Edinburgh.

An astounding fact on the foreground of all inquiries respecting the seeds sown by farmers, is that an enormous proportion of them is destroyed or never germinates. This proportion has been computed to amount to two-thirds of the entire quantity sown; and therefore to involve the stupendous annual waste, throughout Great Britain and Ireland, of 4,666,666 quarters of wheat, barley, and oats,—a quantity equal to the support of one million of human beings. The calculation which brings out so appalling a result assumes, that the average quantity of wheat sown on an imperial acre is 3 bushels or 2,685,912 grains, of barley 5 bushels or 3,135,360 grains, and of oats 6 bushels or from 4,241,664 to 4,434,912 grains,—that the greatest produce in the best districts is 17 times the quantity of wheat sown, and 12 times the quantity of barley and oats,—that the average produce of these three grains on the average quality of soil is only seven times the quantity of the seed sown,—that the average number of grains in an ear of good wheat is 44, in an ear of barley 28, and in an ear of oats about 64,—that the average tillering of vital seeds produces three stems per seed of wheat and barley, and two stems per seed of oats,—and that, as an inference from these two last assumptions, the produce of wheat ought to be 44 times according to the grains and 132 times according to the tillering, of barley 28 times according to the grains and 24 times according to the tillering, and of oats 64 times according to the grains and 128 times according to the tillering. It is stated by Mr. Millot, that in 1830 the medium return of wheat for the seed sown, taking the average of all France, was about 5 1-5 times.

The mean produce was 12 hectolitres per hectare.

The maximum produce was 20 hectolitres per hectare.

The minimum produce was 4.62 hectolitres per hectare.

The above, reduced into English weights and measures, gives—

The mean produce 13 1-5 bushels per acre.

The maximum 22 bushels per acre.

The minimum 5 1-10 bushels per acre.

He states the produce in Germany to be 40 hectolitres per hectare, which is 44 bushels per acre; and probably refers (though not so stated by him) to the maximum produce. Some portion, or even a considerable one of the comparative smallness of the actual produce, it is true, must be ascribed, not to a destruction of seeds, but to such thick sowing as crowds the plants, prevents the growth of tiller-stems, and half strangles the process of fructification; but this cause is very far from being general, and can never exist, except in an exceedingly small degree, in any of the farms or districts in which a normal quantity of seed for producing a full crop has been ascertained by experiment, and established by long practice. The actual destruction or non-germination of an enormous proportion of the seeds, is clearly a fact of general prevalence, and strongly challenges the most interesting investigation.

One portion of the loss of sown corn-seeds is easily traceable to birds; and whatever amount of this is occasioned by the overharrowing of light soils, might be prevented. Another portion of the loss is traceable to the bursting and rotting effect of too much moisture; and whatever amount of this is occasioned by the stagnation of rain-water in furrows and hollows, ought to be ascribed to bad tillage or insufficient drainage. A third portion of the loss is traceable to the trampling of the horses, pressing the seeds beyond the action of the air, or making holes over them for stagnant water; but this, in the present state of husbandry, cannot be avoided. A fourth portion of the loss is traceable to the exclusion of air by adhesive clays, or undue exposure to frost or heat by sandy soils; and this, as well as the greater evil of comparative infertility, might be cured by a little geological improvement. A fifth portion of the loss is very probably caused by the depredations of the numerous insects which inhabit the soil; yet, as the seed is not eaten by them, but damaged or destroyed in consequence of their peculiar habits of existence, this source of loss is a proper subject of investigation for entomologists. A sixth portion of the loss is, in some instances, very probably caused by noxious metallic salts existing in combination with the soil; and this evil, as well as other evils of greater magnitude, forms a decided reason for a careful, chemical analysis of soils. A seventh portion of loss is possibly, though not certainly, traceable to high electric influence; and this consideration, in spite of being merely theoretic,

is strong enough to concur with reasons of greater weight for urging upon scientific agriculturists the study of electricity and of electric agency on soils and vegetation. An eighth portion of the loss is, in many instances, manifestly occasioned by the over-ripeness, the bad preservation, or the otherwise damaged vitality of the seeds; and this—often a very abundant portion of loss—may easily be prevented by using only seed-corn, all the grains of which, when tested in the sample of one or two handfuls, will sink readily in water. A ninth portion of the loss—and this both a general and a large portion—is caused by damage to the seed, or absolute destruction to its vitality, from the blows of the scutchers or the flail in thrashing; and this ought to be prevented by a slow, cautious, and quite partial thrashing of the selected sheaves for seed-corn, leaving the remainder of them to be afterwards thrashed in the usual manner for edible grain. A tenth portion of the loss, and the last we shall mention, is indiscriminate sowing, or the want of adaptation in the quantity of the seed to the powers of the soil. To give the same quantity or even variety of seed to all sorts of land, good, bad, and indifferent, is an error as discreditable as it is common. “Experiments instituted and conducted with care for a series of years, on the quantity of corn which is required to sow various kinds of land in different situations, would doubtless present most important results. But to render these experiments as conclusive as they should be, the land ought previously to be thoroughly drained, in good heart, and under judicious treatment. With these means and appliances to the land, and a few authenticated experiments of the quantity of seed requisite for sowing the various qualities of land, we have no doubt it would be proved that much less seed would be sufficient to produce even better crops than we reap; and though natural causes will always exist to check our hopes of enjoying a prolific crop every year, a considerable saving would annually accrue in seed-corn.” Were due care used to avoid all the occasions which we have pointed of damaging or destroying seed-corn both before and after sowing, or rather were care used to avoid such of them as are perfectly under our control, probably about one-half of the quantities of seed-corn at present sown would be found quite sufficient, and the crops from them would be very observably improved.

Adaptation of the variety of seed to soil and climate, is not only a general preventive of partial loss of seed-corn, but sometimes a requisite to the growth, the health, or the fructification of a whole crop. The change of most good varieties from one soil to another—provided the soils are not widely different in character—often stimulates the seed, and prevents it from degenerating; but any change from one set of influences to another set of considerably different power—espe-

cially as respects the combined influences of temperature and moisture — is frequently followed by disastrous consequences. Thus, some varieties of oats, the Angus, and others, which succeed well in most parts of Scotland, do not fill in the ear, but shrivel up after blossoming, in the southern counties of England; and some varieties of wheat, such as the woolly-chaffed white sorts, which succeed well in Kent and Essex, rot in the ear under the comparative moisture of even the climate of Lancashire. Special varieties of pease and beans, in particular, require a very nice adaptation to both soil and climate; and as an example of this, the early varieties of pease, in all respects grow and mature well on the hot gravelly soils of the south of England, while the late grey pea, in the same circumstances, produces no pulse and but little haum. Any farmer, when settling in a district with whose agricultural conditions he is not thoroughly acquainted, will, for a year or two, do well to select only the best seeds which he can find in the immediate neighbourhood, contenting himself with merely cleaning them from imperfect grains and from the seeds of weeds.

The use of only unmixed, unadulterated, unde-generated seeds, is not quite so easy as most young farmers might suppose, and vastly more important than they are likely to conjecture. Many seeds which appear good have naturally lost their vitality; many, especially of the clover classes, are, by chemical appliances, doctored from a state of rottenness into an appearance of soundness; many, of almost all sorts, are mixtures of good, bad, and indifferent; many have been procured from dwarfish, stunted, or unhealthy plants; and many belong to degenerated, obscure, or worthless varieties. If rape seed have not been procured from the strongest and largest rooted plants, it will not, even on the best soils and under the best treatment, produce a good crop. If the seeds of carrots or of mangel-wurzel have been obtained from plants with small, deformed roots, they will, in any circumstances, produce a poor and sickly growth. If the corn-seed of wheat, no matter how plump and good-looking in itself, belong to certain unprolific varieties, it may not yield much more than three-fourths or four-fifths of the crop which would rise from seed of the choicer varieties. If turnip seed be mixed with the seed of other plants of the genus *Brassica*, or have been obtained from plants of small roots and degenerate character, it will probably produce the merest and most wretched apology for a crop. "Five and twenty years ago," said Mr. P. Shirreff in 1828, "the variety of turnip cultivated in East Lothian, was spurious and worthless in the extreme; but since its seed has been judiciously propagated, the crops of this root have been improved in nutritious value upwards of three hundred per cent." The propagation of only unde-generated seeds of the best varieties, while it would greatly increase

the bulk of crops and considerably improve their quality, is an improvement which neither destroys any existing investment of capital nor involves any new expenditure of money or labour, but only requires a little attention in the selecting of seeds, a little patience in propagating them, and a little care in keeping them free from intermixture. Mr. Shirreff calculates that, as the result of a few years' practice of this most cheap and easy improvement, the disposable produce of each farmer might probably, on the average, be increased nearly ten per cent.; and he adds, "The facility of propagating genuine seeds will become manifest from a statement of my practice. In the spring of 1823, a vigorous wheat plant, near the centre of a field, was marked out, which produced 63 ears that yielded 2,473 grains. These were dibbled in the autumn of the same year; the produce of the second and third seasons was sown broadcast in the ordinary way; and the fourth harvest put me in possession of nearly forty quarters of sound grain. In the spring of this year (1828) I planted a fine purple-top Swedish turnip, that yielded (exclusive of the seeds picked by birds, and those lost in thrashing and cleaning the produce) 100,296 grains, a number capable of furnishing plants for upwards of five imperial acres. One-tenth of an acre was sown with the produce, in the end of July, for a seed crop, part of which it is in contemplation to sow for the same purpose in July 1829. In short, if the produce of the turnip in question had been carefully cultivated to the utmost extent, the third year's produce of seed would have more than supplied the demand of Great Britain for a season."

The power of distinguishing new or special varieties of seeds, and of instantly or rapidly forming a judgment of their comparative value, is of great importance to any farmer, not only for his guidance in selecting seeds by purchase, but for enabling him to detect any desirable new varieties which might happen to appear among his own crops. "Valuable varieties," remarks Mr. Bishop in his *Casual Botany*, "may sometimes appear to those who have it not in their power to prove them by trial; and if they have, the probability is, that the means to be employed require more care, time, and attention than they are disposed to bestow on plants the merits of which are doubtful; whereas were such persons capable of forming an estimate of the worth of varieties from their appearance, then would they use means for their preservation, whenever their appearance was found to indicate superiority. That this is an attainment of considerable importance, will be readily allowed; yet that it in some cases requires the most strict attention, appears from the circumstance of varieties being oftentimes valuable, though not conspicuously so. Let us suppose, for instance, that in a field of wheat there exists a plant, a new variety, having two more fertile joints in its spike, and equal to the surrounding wheat in every other respect, a

man accustomed to make the most minute observations would scarcely observe such a variety, unless otherwise distinguished by some peculiar badge; nor would any but a person versed in plants know that it was of superior value if placed before him. How many varieties answering this description may have existed and escaped observation, which, had they been observed and carefully treated, would have proved an invaluable acquisition to the community! The number of fertile joints in the spike of the wheat generally cultivated, varies from eighteen to twenty-two; and the inhabitants of Great Britain and Ireland amount to nearly the same number of millions; therefore, as the wheat produced in those islands has been of late years sufficient, or nearly sufficient, to supply the inhabitants thereof with bread, it is evident that a variety with two additional fertile joints, and equal in other respects to the varieties at present in cultivation, would, when it became an object of general culture, afford a supply of bread to at least two millions of souls, without even another acre being brought into cultivation, or one additional drop of sweat from the brow of the husbandman."

One grand means of improving seed-corn is, on the first occasion of sowing, to obtain the finest and most productive quality suitable to the particular soil and climate, to clean it, as thoroughly as possible, from all broken grain and seeds of weeds, and to give it the best conditions of cultivation which good draining, good tillage, and good exposure can command; and then, for a series of years, at the time of the ripening of the crop, to select as large a number, as time and circumstances will permit, of the strongest and healthiest of the plants for the seed-corn of the next year's sowing. Two plants growing beside each other, under the same conditions of culture, often differ widely in both their total and their nutritious contents; and the practice of selecting some of the strongest and plumpest for intermixture with the portion of crop set apart for seed-corn, would have the additional advantage of creating the habits of minute and discriminating observation which Mr. Bishop desiderates, and might probably lead to the detection of some entirely new and valuable varieties. Plants which grow together in enormous numbers like the cereal grains and the other common vegetable productions of a farm, are constantly exhibiting individual instances of great change in their habits of growth, of development, and of fructification, from the operation of chemical agency in the soil, of obscure expansions or contractions in the individual organism, of electric or gaseous influence in the atmosphere, of the hybridizing power of foreign varieties which happen to be present, and of several other causes to which superficial thinkers are not likely to advert; and were the plants raised from choice and selected seed, observed from year to year with a tolerably knowing eye—were they even glanced at, along the

sides of a field, during a few minutes of each of several days when their ripening is in progress—they could scarcely fail, on almost every farm, to present some specimens which would richly reward the observer's care. Yet a judicious man, in all his observations and efforts for the improvement of seed-corn, will bestow an hundredfold more pains in improving a confessedly good variety already in possession, than in nursing a new variety of doubtful character, or making a strenuous effort to offer an original contribution to the good varieties of the shops. Some farmers—and these not always well qualified for the task—seem to have almost a passion to become the discoverers of new varieties of grain, and to give their names in connexion with them to the world; and many have expended large portions of their time in watching, and nursing, and forcing pet plants of their detection, with no other result than blank disappointment, or at the best the contribution of varieties which had little or nothing to recommend them but their novelty. The system of accidental discovery, in fact, has, with a very few exceptions, been a plague to the discoverers, and a nuisance to the world; and hence the necessity of new varieties being sought only by minute, practised, and scientific observation, or by the artificial but still more certain process of hybridizing.

Hybrid plants have a character among vegetables exactly corresponding to that of mules among animals; and they may, like mules, be produced either with or without the interference of man. See article *HYBRIDS*. The pollen or fecundating dust of a plant of one variety is sprinkled upon the stigma or reproductive organism of a plant of another variety; and the ripened seeds of the latter produce plants which combine the properties of both varieties, probably wanting the objectionable properties of each, and possessing the desirable properties of both. Some hybrids, of course, may be sheer deteriorations; some may be merely equal in worth to either of the parent varieties; and only some are decided improvements, and these in various degrees. As hybridizing proceeds without as well as with human interference, it may often be a source of the partial deterioration of a portion of the seed-corn of crops; and it ought to be a decided reason for every farmer sowing a field with only one variety of seed, and using care to keep every prime variety perfectly unmixed. "Hybrid varieties of agricultural plants, when suffered to intermingle with the original kind, disseminate their influence around them like cross-bred animals, unrestrained in their intercourse with the general herd, till the character of the stock becomes changed, and consequently deteriorated or improved." Care should be exercised also not to use any hybrid which has directly sprung from very widely different varieties; for such hybrids, like those between two species of a genus, may continue fertile during only three or

four generations, and may then either die out, or revert to the type of one of the varieties whence they sprung. Some genera of plants, too, far more readily and healthily hybridize than others; and unhappily wheat is one of the genera most averse to the process. But, with these precautions, hybridizing is a power of great moment, and, if generally understood and used, might be made subservient to the great and rapid improvement of all agricultural seeds. The flowers of turnips, cabbages, and other plants of the brassica genus, are fully open to the action of light winds and the contact of insects; and they, in consequence, often receive cross-impregnation by the scattering of pollen, and have, for thirty years past, produced so many most valuable new varieties, that the aggregate value of the genus to the farmer has already become doubled and almost trebled. Dale's hybrid turnip, and the amazingly improved turnips in the general husbandry of Scotland, are illustrations of the wonders which may be effected. Even wheat may, with great promise, be artificially hybridized. "The anthers or male part of wheat and other cerealea seldom escape from their casement till after the ear has been four or five days developed, according to the state of the atmosphere; and this process takes place when the air within the glume is suddenly expanded by sunshine succeeding a clouded or misty atmosphere. The same cause produces the same effect on the envelop of the pollen, and the fecundating pollen is partially discharged before the anthers explode from their confinement. It is true that much pollen is shed outside the glume; but Nature is profuse in all her works connected with the preservation of the species, and the pollen which falls from the dangling anthers, after having fulfilled the purposes requisite for the extension of vegetable life, may be intended by the beneficent Author of Nature to feed myriads of insects, which, however minute, are still the objects of his care. It might be considered as offering an insult to the understanding of the farmers of the present day, to inform them that these yellow anthers are the male parts of the flower. Taking it for granted that this fact is generally known, the mode of 'crossing' for 'improving the breed' is obvious. The first day that wheat, oats, or barley, comes in the ear, let the farmer select a few stalks as breeders; and, with the forefinger of his left hand, pressing gently on the point of the chaffy cover, let him force it open, and with a pair of small pointed scissors in the right hand, let him cut out the three yellow anthers not yet opened, and let the chaff spring back to protect the stigma and embryo grain. After four days, let him return to the same stalks with the male flowers, or parts of the flowers of the variety with which he means to cross, open up the glumes as formerly, and dust the stigma gently with the pollen. One stalk of barley, oats, or wheat, treated in this manner, and the grains carefully

sown, may produce several new improved varieties. Pease and beans, too, have their parts of fructification concealed by the papilionaceous corolla, and by similar treatment may produce similar results."—[*Mr. Gorrie in Quarterly Journal of Agriculture.*]

The grass or pasture seeds have been already glanced at in the article AFTERGRASS, and will occur to be fully discussed in the article GRASSES, yet may here form a suitable topic of two or three remarks. They have been economically arranged into the three classes of seeds, belonging to respectively proper grasses for permanent pasture and for alternate husbandry,—clover or pea-blossomed plants, partly for intermixture with the proper grasses, but chiefly for green food, and for hay,—and miscellaneous plants, either for intermixture with the proper grasses, or for separate sowing with the view of improving land. The best of the proper grasses for the uses of the farmer are *Alopecurus pratensis* or meadow fox-tail grass, *Poa pratensis* or smooth-stalked meadow grass, *Poa trivialis* or rough-stalked meadow grass, *Festuca pratensis* or meadow fescue, *Cynosurus cristatus* or crested dog's-tail grass, *Festuca duriuscula* or hard fescue, *Holcus lanatus* or woolly soft grass, *Holcus avenaceus* or tall oat-like soft grass, *Phleum pratense majus* or large meadow cat's-tail grass, *Lolium perenne Russelianum* or Russel's perennial ryegrass, *Hordeum pratense* or meadow barley-grass, *Festuca ovina* or sheep's fescue, *Agrostis stolonifera latifolia* or fiorin, *Lolium Italicum* or Italian ryegrass, and *Panicum Germanicum* or German panic grass. The best of the clovers or pea-blossomed plants are *Trifolium pratense* or broad-leaved red clover, *Trifolium pratense perenne* or cow-grass or perennial red clover, *Trifolium repens* or white clover, *Trifolium minus* or red suckling, *Medicago lupulina* or non-such or hop trefoil, *Medicago sativa* or lucern, and *Hedysarum onobrychis* or saintfoin; and the best of the miscellaneous plants of a nature fit for intermixture with the grasses, are *Poterium sanguisorba* or burnet, *Achillea millefolium* or yarrow, *Spergula arvensis sativa* or cultivated meadow spurrey, and *Plantago lanceolata* or lamb's tongue or rib-grass.

The proper grasses which we have named constitute the produce of every rich old permanent pasture; and, in all judicious artificial sowings, are intermixed with clovers, particularly the white and the perennial red, in different proportions according to the character of the soil. If only one species of grass be sown—no matter which species, or how thickly sown, and no matter what the character or condition of the soil—only a portion of the plants will prosper, and blank spaces will occur everywhere among them, to be speedily occupied by whatever grasses, weeds, rushes, or mosses, are ripening in the vicinity, and have a liking for the soil; but if a mixture of different species and of sufficient quantity be sown, the plants which spring from them will densely cover every portion of the sur-

face, and give it the properties of an ancient meadow or rich old pasture. When the soil is highly fertile or of a very compound nature, the mixture of seeds sown upon it ought to comprise a considerable number of species; but when the soil is thin, poor, or of simple character, especially when it consists of chalk, damp clay, siliceous matter, or moorish and heath-growing gravel, the mixture may comprise but few species, and, in some instances, not more than three or even two. The lowest degrees of these poor, thin, and semi-barren soils, in fact, almost as steadily refuse to produce more than one or two solitary species, as the rich, compound, arable soils refuse to bear fewer than four, six, eight, or a dozen. Just, therefore, as the prime pasture grasses are naturally found growing in a state of abundant intermixture with one another on rich soils, so are the hard, harsh, worthless kinds of grasses naturally found growing in solitary sternness on wild moors, on arid sands, on ferruginous clays, and on other descriptions of almost desert lands. Thus the grasses *Aira flexuosa* or zigzag hair-grass, *Nardus stricta* or upright mat-grass, *Secleria cerulea* or blue moor-grass, *Melica cerulea* or purple melic, *Agrostis canina capillaris* or dog bent, *Agrostis palustris* or marsh bent, *Poa aquatica* or watery meadow grass, and several others, are generally found uncombined with one another, or with other grasses, and, if sown in a state of mixture, no matter of what kind, in what proportions or upon what soils, will refuse to continue social, and eventually become solitary. Even the decidedly good pasture grasses are much affected in their habits of growth, gregariousness, and longevity, by the different qualities of soils, and require to be modified, as to both the kind and the proportion of mixture, in order to be profitably adapted to different situations. In a sandy loam, for example, *Festuca pratensis* and *Festuca duriuscula* ought to be in nearly equal proportions; in a sandy soil, with little or no loamy matter, *Festuca duriusculus* ought to be in much larger proportion than *Festuca pratensis*; and, in clayey loam, *Festuca pratensis* ought to be in twice the quantity of *Festuca duriuscula*. Most of the other prime grasses require similar adaptation; and nearly all will suffer more or less diminution of their fertility or their permanence by either indiscriminate mixture or indiscriminate sowing. See articles SEED, GERMINATION, COTYLEDONS, SOWING, GRASSES, AFTERGRASS, VARIETIES, WHEAT, BARLEY, and OATS.

AGRICULTURAL SHOWS. Public exhibitions of farm stock, farming implements, and other matters connected with agriculture. They are appointed and conducted by agricultural societies, and are designed to stimulate agricultural genius and enterprise, to diffuse agricultural information, and to give popularity and importance to valuable agricultural discoveries; and they serve also to lift agricultural interests triumphantly above the influence of factions and

partisanship, to excite and expand the feeling of reciprocal interest between landlords and tenants, and to diffuse a *corps d'esprit* throughout the various members of the agricultural body. See next article.

AGRICULTURAL SOCIETIES. Associations for the diffusion of agricultural science, and the promotion of agricultural improvement. Some are institutions for a kingdom, others for a province, and others for a very limited locality; some consist of scientific and wealthy patrons and proprietors, and others of enterprising farmers and ordinary farm-stewards; some exert a motive power on the energies of improvement, both suggesting enterprise and conducting it, and others exercise no stronger influences than those of sanctioning and news-spreading, contenting themselves with the adoption of well-tested practices, and the diffusion of valuable information; and some are supported wholly or partly by state endowment, others by munificent and numerous benefactions and subscriptions, and others by few and meagre private contributions. Many of the more obscure, feeble, and limitedly local class have had but a brief and comparatively worthless existence; some others of this class are of questionable character, probably doing as much evil as good; and the remainder—constituting the great majority—have acquitted themselves well and powerfully, and are wielding a vast aggregate energy for the welfare of the agricultural community, yet are cumulatively far too numerous, and individually far too small, to be fit subjects of detailed notice, or even of enumeration. Agricultural societies, as a whole, are increasing in both number and power, and have already achieved incalculable benefit throughout many parts of Europe, and particularly in Germany, France, and Great Britain. Both their objects and their results are well-known to almost all the reading population who speak the English language, and furnish topics of constant, varied, and extensive notices in all our periodicals, from the daily newspaper to the quarterly scientific journal. “The newspapers of the passing day teem with the list of prizes offered in Great Britain for improving live stock in all their varieties, the invention of new farming implements, &c., &c., and for procuring the best information on all subjects connected with every department of rural and domestic economy. The exhibitions of horned cattle, horses, sheep, and swine, have produced the most beneficial effects in the principal as well as in the least favoured breeding districts; and, by a necessary connexion, tillage in all its branches has been promoted. Farm servants, too, have become objects of encouragement; their skill in ploughing, hedging, stack-making, herding, dairy-management, cottage-husbandry, their morality of conduct, and length of servitude, being subjects of approbation and reward.”

The Highland and Agricultural Society of Scot-

land was founded so early as 1784, and has run a career of distinguished splendour, and maintains undoubted pre-eminence over all agricultural associations. It has effected great and numerous improvements throughout most of Scotland; it has exalted that country, in spite of the poverty of its soil and the angriness of its climate, to the first place among the agricultural countries of the world; it has exerted a powerful though indirect benign influence on England, Ireland, and the whole civilized world; it possesses, in its museum, in its periodical shows, and in its constant array of wealth and talent, a series of the finest displays of patriotic munificence which ever graced the history of any mere economical association; and it has produced, in the many volumes of its Transactions and of its Quarterly Journal of Agriculture, by far the most opulent mass of interesting, practical, and scientific information which anywhere exists within the wide circle of agricultural literature.—The English Board of Agriculture and Internal Improvement was established in 1794; it had as its president Sir John Sinclair, as its first secretary Mr. Arthur Young, and as its patrons and directors a very large body of the most distinguished men in England, including all the great officers of state, the two archbishops, and many of the nobility; it produced, in a remarkably short period, seventy-two octavo volumes of reports on the agricultural condition of the counties of the empire; it united the influence and exertions of men of all political parties in a series of efforts for the agricultural and general improvement of the country; and, with a very sensible degree of permanent beneficial results, it aroused a large proportion of the farmers in most parts of England and Scotland to a consciousness of deficiency in their agricultural practices, and a conviction of both the desirableness and the practicability of great improvement.—The Royal Agricultural Society of England, originally called the English Agricultural Society, though quite recent in origin compared with the Highland and Agricultural Society of Scotland, has already for several years begun to exert nearly as powerful an influence upon England as that great institution does upon Scotland, and is running a course of noble rivalry with it in the support of minor beneficial institutions, in the holding of great agricultural shows, in the stimulating of agricultural talent, and in the publication of a valuable course of agricultural periodical literature.—The Royal Dublin Society was incorporated for the advancement of husbandry, manufactures, and the fine arts; it at one time promised to arouse the sleeping energies of Ireland, and made a series of exertions for that country similar to those of the English Board of Agriculture for England; it afterwards, for a long period, ceased to take almost any part whatever in matters connected with agriculture, yet had the apology, during some of that period, that the interests of Irish agriculture were professedly

promoted by the now-extinct Farming Society; and, for some years past, it has again begun to hold annual exhibitions of cattle, poultry, and agricultural implements, to give premiums for the best specimens of these, and to offer prizes for essays on subjects connected with the farmer's interest.—The Royal Agricultural Improvement Society of Ireland, but a recent institution, boasts great numerical strength in its members, high personal and official distinction in its principal supporters, and comparative munificence in the contributions to its funds; and it was founded to embody all sorts of practical and scientific information connected with agriculture, to correspond with the principal agricultural societies of Britain, continental Europe, and America, to propose agricultural experiments and defray such losses as they might occasion, to promote improvements in the construction of agricultural implements and of farm buildings and cottages, to encourage and direct the application of chemistry and other sciences to husbandry, to promote improvements in the breeds of live stock and in veterinary surgery, to stimulate knowledge and neatness in the management of cottages and gardens, and to promote the comfort, the education, and the general welfare of small farmers and agricultural labourers.

AGRICULTURE. See GENERAL INTRODUCTION.

AGRICULTURIST. See AGRICULTOR and FARMER.

AGRIMONY, or HERB-AGRIMONY,—botanically, *Agrimonia*. A genus of hardy and perennial plants of the Rose tribe, distinguished from all the other genera of that tribe by their having small, notched petals, from seven to twenty stamens, only two or three pistils, and these last enclosed in the deep tube of the calyx. The number of species cultivated in Great Britain is six; and the total number known is nine. The most common species, or that to which the popular name herb-agrimony probably belongs, *Agrimonia eupatoria*, grows wild in most parts of England, and is an erect, hairy, herbaceous weed, troublesome in pasture grounds, and frequent by the sides of hedges, on the skirts of woods, and on other descriptions of untilled ground. Its stem is round, rough, nearly simple, and eighteen inches or two feet high; its leaves are interruptedly winged, with oval and coarsely serrated leaflets; and its flowers are small and yellow, and grow alternately along the stalk, in a long row, after the manner of a spike, and are succeeded by little rough seeds, having some resemblance to miniature burs. An infusion of agrimony is used by the peasantry of the south of England as a medicinal tea in feverish colds; and various preparations of the plant are extolled by quacks and herbalists as replete with healing power. Agrimony, say these unhesitating authorities, is carminative, astringent, detergent, aperient, and resolvent; a decoction of it removes obstructions of the liver, cures jaundice, relieves dropsy, expels

worms, and is an excellent remedy in diabetes ; an ointment made from it heals wounds, ulcers, burns, and blows, draws out thorns or splinters from the flesh, and heals luxations and bones forced out of joint ; and these or other preparations alleviate coughs, and operate as a panacea against one-tenth or so of all the diseases of the human frame. We entreat farmers to protect their families and dependents from the practices of quackery.

AGROSTEMMA. See CAMPION (ROSE).

AGROSTIS. A genus of grasses, of a creeping habit, and with loose branched, capillary panicles of flowers. Most of them are popularly called *bent-grass* ; two of the best known British species are regarded in England as troublesome weeds, under the name of *quitch* or *quicks* ; and a variety of one of the species has, for about thirty years, had great celebrity as a pasture grass, under the name of *forin*. They are distinguished from all other British grasses, by the outer scales of their flower being two in number, unequal in size, membranous in texture, and containing but a single floret, and by the inner scales being also two in number, short, very thin, and almost transparent, and the larger of them occasionally having an awn at its back. Some of the species grow in rank, marshy grounds, and some in dry, exposed, barren situations ; and most have hitherto been regarded as useless or even noxious to the farmer. Yet the genus has been the subject of so much controversy, and one or two of its species, or at least some varieties of those species, have been so highly extolled as of supereminent value, that a number of the several species and their known varieties require to be distinctly noticed.

Agrostis vulgaris, or common bent, is the most common grass on many natural sandy pastures in most parts of England ; it abounds on not a few good soils, in elevated and exposed situations ; and, in consequence of the rapidity with which it overruns pasture and garden ground, it is usually denounced by English farmers under the name of *quicks*, and exterminated as an annoying weed. Yet in spite of being a hard grass, containing comparatively little nourishment, it might probably, in some situations, demand favour from the farmer on account of its early habits ; for it flowers from the third week of June till the third week of July, and matures its seeds before the end of August. Four varieties of *Agrostis vulgaris* are enumerated under the names of *mutica*, *canina*, *pumila*, and *syriatica* ; and one of these is distinguished by having awned healthy flowers, one by having awnless diseased flowers, one by having awned diseased flowers, and one by having viviparous flowers. The *mutica* and the *canina* are the most common varieties ; and they remarkably differ from each other in at once character of soil, earliness of habit, and nutritiousness of constitution. The *Agrostis vulgaris mutica* prefers sandy soils, flowers

from the third week of June till the second week of July, ripens in the beginning of August, and, on sandy soil, yields per acre when in flower 10,209½ lbs. of green produce, 4,595 lbs. of dry produce, and 532 lbs. of nutritious matter,—and when in seed, 9,529 lbs. of green produce, 4,765 lbs. of dry produce, and 252 lbs. of nutritious matter. The *Agrostis vulgaris canina* prefers clayey soils, flowers in the second and third weeks of July, ripens in the end of August, and, on sandy loam, yields per acre when in flower 6,126 lbs. of green produce, 2,604 lbs. of dry produce, and 240 lbs. of nutritious matter. The *mutica* is generally healthy, and obtains the popular names of common bent and fine bent ; but the *canina* is attacked by rust in both its culms and its leaves, and is usually called brown bent. The *mutica*, as may be seen at a glance, is, in all respects, much superior to the *canina* ; and is the variety distinguished, par excellence, as bent, common bent, and *Agrostis vulgaris*.

Agrostis alba or white bent, shares with *Agrostis vulgaris* the English husbandman's contemptuous designation of *quicks*, and indignant denunciation as a troublesome weed ; and they are the only species very distinctly known to most farmers, or even noticed in some scientific treatises. *Agrostis alba*, too, has the contradictory character in England of a bad plant and a good plant,—bad in some situations and good in others ; and while denounced in the former character as *quicks*, it has often been erroneously identified in the latter character with the Irish *forin*. *Agrostis alba* grows luxuriantly in either marshes or clayey grounds ; it takes stout and monopolizing possession of the soil, greatly exhausts it, and cannot easily be eradicated ; it has smaller roots than any of the other species of *agrostis*, and can, at any stage of its growth, be easily recognised by this characteristic ; it flowers in the first week of August, and ripens about the beginning of September ; and, on clayey soils, it yields per acre when in flower 8,167½ lbs. of green produce, 3,471 lbs. of dry produce, and 255 lbs. of nutritious matter.

Agrostis palustris, or marsh bent, has a promptly stoloniferous habit, and is considered by some persons as not sufficiently marked to be a distinct species, or as only constituting a variety of *Agrostis stolonifera*. It grows on stiff clayey soils, abounds in marshes, and occurs oftener in moist woods than any other of the stoloniferous grasses ; but it requires so much moisture in order to its thriving as to be properly a sub-aquatic ; and, in some watery situations among woods and shrubs, where it can obtain support from bushes, it often attains a height of five feet. It is greatly superior in useful properties to *Agrostis alba*, and will even bear comparison with the best kinds of *Agrostis vulgaris* ; but it is much inferior to most sorts of *Agrostis stolonifera*, and can be viewed as little better than a weed, infesting spouty grounds, and choking up drains and cop-

pices. It flowers about the second week of July, and ripens about the third week of August; and when growing upon boggy ground, it yields per acre when in flower 10,209½ lbs. of green produce, 4,534½ lbs. of dry produce, and 438½ lbs. of nutritious matter,—and when in seed 13,612½ lbs. of green produce, 5,445 lbs. of dry produce, and 585 lbs. of nutritious matter.

Agrostis stricta, upright bent or rock bent,—called by some botanists *Trichodium rupestre*,—grows on dry, sandy, rocky soils, and is distinguished at a glance from all the other bent grasses, by its possessing a fine deep, green colour. It requires little stimulating from either soil or manure; it impoverishes in only a small degree any soil on which it grows; and if cultivated, without manure, on poor, siliceous, thin, and half-waste ground, it will for six successive years yield a full and undiminishing return of crop. On account of these properties, it may, in certain situations, be worth the attention of some farmers; yet it possesses comparatively little intrinsic value, and can be profitably cultivated only on soils which refuse to bear any other forage, and cannot be remuneratingly reclaimed. When grown on bog, *Agrostis stricta* yields per imperial acre when in flower 9,528½ lbs. of green produce, 4,764½ lbs. of dry produce, and 251½ lbs. of nutritious matter,—and when in seed 7,487 lbs. of green produce, 2,714 lbs. of dry produce, and 178 lbs. of nutritious matter.

Agrostis repens, creeping-rooted bent or white creeping bent—called by Withering *Agrostis nigra* or black couch grass—often grows on pasture and corn-fields, takes powerful hold of the soil, has a pertinaciously stoloniferous habit, and gives great trouble and vexation as a weed. So exceedingly vivacious is it that the least particle of root or stolon will become a plant; and so penetrating and ramified in its intertexture with the soil, that ploughing will not erase it from clayey land, and paring and burning will do it little damage in almost any ground. The only successful or at least advisable method of attempting its extirpation, is to follow the plough, to fork out the roots, and to use care that none be left to strike anew on the surface. A peculiar disease, of the nature of rust, attacks this species, dries up the extremity of its leaves, and gives it an unsightly appearance. *Agrostis repens* flowers in the second week of August, and ripens toward the end of September; and, on clayey loam, it yields per acre when in flower 6,125½ lbs. of green produce, 2,680 lbs. of dry produce, and 287 lbs. of nutritious matter.

Agrostis nivea, snowy bent or straw-coloured bent—called by some botanists *Trichodium caninum*—grows on either heathy or clayey soils, but bears two times more produce on the former than on the latter; it is a plant of too infrequent occurrence to be formidable as a weed; and it is too meagre in nutritious properties, and too unaccommodating to any peculiarly waste soil, to

become an object of cultivation. It flowers about the second week of August, and ripens about the beginning of September; and when growing on sandy soil, it yields per acre when in flower 6,125½ lbs. of green produce, 2,603½ lbs. of dry produce, and 239½ lbs. of nutritious matter,—and when in seed 4,764½ lbs. of green produce, 1,310½ lbs. of dry produce, and 149 lbs. of nutritious matter.

Agrostis lobata, lobed bent or sea-side bent, grows partly on wet stiff clayey lands, such as those of the most adhesive portions of the London clay basin, but is found principally on soils of various descriptions in the immediate vicinity of the sea; and though it is of considerably less economical value than the *Agrostis vulgaris mutica*, it might probably be well worth cultivation in many situations which are exposed to the storm-spray of the sea, or to frequent and dense coast mists. Its seeds are produced in great abundance, and germinate with great freedom and vigour. It flowers in the first week of August, and ripens about the end of the same month; and as grown upon siliceous sand, it yields per acre when in flower 6,806½ lbs. of green produce, 3,403 lbs. of dry produce, and 319 lbs. of nutritious matter,—and when ripe 6,125½ lbs. of green produce, 2,680 lbs. of dry produce, and 287 lbs. of nutritious matter.

Agrostis Mexicana, or Mexican bent, is a native of the country whose name it bears, and was introduced to Britain in 1780, by Mr. Gilbert Alexander. It grows freely in a variety of soils, but is much fonder of such as are calcareous or argillaceous than of such as are siliceous or moory. Its seeds are produced in abundance, and vegetate with freedom and power. Though quite a hardy plant, it may nevertheless retain some disadvantageous properties which a longer and more thorough acclimation will considerably modify. At present, it is late in throwing out its foliage, and it but very slightly excels *Agrostis palustris* in useful properties as herbage; so that, except for the rapidity and energy with which it rises from seed to maturity, it possesses no great claim on the attention of the farmer. It flowers in the third week of August, and ripens toward the end of September; and when grown upon rich, black, siliceous, sandy soil, it yields per acre when in flower 19,057½ lbs. of green produce, 6,670 lbs. of dry produce, and 595½ lbs. of nutritious matter.

Agrostis ramosissima or side-branching bent, is distinguished by the number of branches which ramify from its stem, and by such a hard and semi-ligneous texture of its culms as somewhat assimilates it in character to an undershrub. Its herbage is late in appearing, and acquires little bulk before the beginning of summer; and its flowers do not appear till the first or second week of October, and are very seldom, even in the south of England, succeeded by more than mere embryo seeds. The frost not only prevents its fructification, but destroys its foliage, killing it down to

the surface of the ground, and permitting nothing but its roots to escape; and the plant is propagated by the parting and transplanting of its roots late in autumn or early in spring. This species, when in flower, and when grown upon a strong clayey loam, yields per acre 28,586½ lbs. of green produce, 11,434 lbs. of dry produce, and 893½ lbs. of nutritious matter; so that, excepting some species of *Agrostis stolonifera*, it is the richest in nutritious properties of all the bents.

Agrostis canina mutica, awnless brown bent or creeping-stalked brown bent—called by some botanists *Trichodium caninum muticum*—has a strongly aquatic habit, abounds more than any other grass on deep bogs, and may often be seen in luxuriance on such boggy grounds as are under water during six months in the year. It is a small plant, seldom having leaves of more than three inches in length; it produces too little herbage, and possesses too little nutritious matter, to be ever deserving of cultivation; and it is of use to the farmer principally in indicating to him that the soil on which it grows is capable of being converted into rich meadow by irrigation. It closely resembles *Agrostis nivea* in general structure; and principally differs from it in the want of awns and in the length of the culms. It resembles *Agrostis canina fascicularis* in having knots or bundles of leaves attached to its decumbent shoots. It flowers in the second and third weeks of July, and ripens about the middle of August; and when growing on bog, it yields per acre when in flower 5,445 lbs. of green produce, 1,497½ lbs. of dry produce, and 149 lbs. of nutritious matter,—and when in seed 6,125½ lbs. of green produce, 2,603½ lbs. of dry produce, and 239½ lbs. of nutritious matter.

Agrostis canina fascicularis, tufted bent or bundle-leaved bent, abounds on poor, light, moist soils, which lie on a retentive subsoil, and have long been under pasture; and, in common with the woolly soft grass, it is, in some districts, popularly designated winter fog. Tufts or bundles of leaves rise from its shoots in autumn, and run along the surface of the other herbage; and this phenomenon gives the variety its name of *Fascicularis*, constitutes the distinguishing feature of that variety, and is caused by the cattle leaving scattered roots of this plant untouched when they are eating the accompanying grasses. This plant is the least valuable of all the bents, and totally unworthy of cultivation; and the chief care which it gives the farmer—and that no mean one—is how he may best root it out or choke it. It flowers in the first and second weeks of August, and ripens in the end of the same month; and when growing upon sandy soil, it yields per acre when in flower 2,722½ lbs. of green produce, 680½ lbs. of dry produce, and 85 lbs. of nutritious matter.

Agrostis canina capillaris or fine-panicled brown bent, grows wild in isolated patches on moors and heath-producing grounds; and is occasionally

found in portions of pasture lands which have a siliceous soil; but it seldom occurs in commixture with any other species of grass. It possesses a close resemblance to *Agrostis canina fascicularis*. It flowers about the beginning of August, and ripens about the end of that month; and when in flower, and growing upon sandy loam, it yields per acre 4,764½ lbs. of green produce, 1,310½ lbs. of dry produce, and 149 lbs. of nutritious matter.

Agrostis stolonifera aristata or awned creeping bent, abounds in bogs, occasionally grows in mixture with other grasses in pastures, and has a strongly stoloniferous habit. It is eaten by cattle in common with the meadow fox-tail grass and the rough-stalked meadow grass; and it produces a much greater amount of nutritious matter than several of the species of bent which we have noticed; but it is very far inferior in value to fiorin, and, if carelessly taken as a fair specimen of the varieties of *Agrostis stolonifera*, is fitted to bring them into great comparative discredit. It flowers about the third or fourth week of July, and ripens about the second or third week of August, and when grown upon bog, it yields per acre when ripe 8,848 lbs. of green produce, 4,210½ lbs. of dry produce, and 368½ lbs. of nutritious matter,—and in the month of December 10,209½ lbs. of green produce, 4,594½ lbs. of dry produce, and 438½ lbs. of nutritious matter.

Agrostis stolonifera angustifolia or narrow-leaved creeping bent, is the most common variety of stoloniferous bent in moist woods, and on cold, retentive, clayey soils. It produces a greater amount of nutritious matter than any other bent except fiorin; yet it does not appear to be relished by cattle, but, on the contrary, is totally neglected by them as long as they can obtain any of the better pasture grasses. It flowers in the second and third weeks of July, and ripens about the end of August; and when grown on bogs, it yields per acre when ripe 16,335 lbs. of green produce, 7,350½ lbs. of dry produce, and 765½ lbs. of nutritious matter,—and in the month of December 17,015 lbs. of green produce, 8,507½ lbs. of dry produce, and 930½ lbs. of nutritious matter.

Agrostis stolonifera latifolia, fiorin or broad-leaved creeping bent, is the grand topic of interest and controversy on the subject of the genus *agrostis*, and has been eulogized by some parties as the most valuable of all the pasture grasses, and contemned by others as one of a series of worthless and annoying weeds. But this variety of *Agrostis stolonifera*, while it is the only true fiorin, and constitutes the only grass referred to by the extreme eulogists of *Agrostis stolonifera*, has a close resemblance to *Agrostis stolonifera aristata*, to *Agrostis stolonifera angustifolia*, and to two other and more obscure varieties of *Agrostis stolonifera*, called respectively *sylvatica* and *palustris*; and, at the same time, it is scarce while they are plenty,—it occurs in comparatively rare and isolated situations, while they are extensively diffused,—it seems to be naturally peculiar

or nearly so to Ireland, while they are found in many parts of England,—it far excels them all, both in quantity of nutritious produce, and in adaptations for winter forage,—and it has vastly oftener been confounded with some one or other of them, or even with several of the still less valuable species which we have enumerated, particularly with *Agrostis alba*, *Agrostis palustris*, and one of the varieties of *Agrostis vulgaris*, than distinguished from them and separately identified. Can we wonder, then, that the most conflicting and even contradictory opinions have been maintained respecting fiorin? The original eulogists of fiorin, too, promulged the praise of its good properties, before fair time had transpired for detecting and estimating its defects; its subsequent eulogists have sometimes been hurried into superlatives by the excitement of controversy; and not a few of its opponents have been indiscriminate and unmeasured in their denunciations, not alone from total mistake of the real plant, but probably from prejudice against Ireland where its praises originated, and from low, perhaps contemptuous, estimation of the general agricultural status of its earlier eulogists. But this subject is at once so important in itself, so interesting in agricultural experiment, so curious in some historical associations, and so complicated in the conflicts and antagonisms of opinion, that we must reserve a full notice of it for a separate article under the word FIORIN, and conclude here with the general statement of one or two botanical and statistical facts. *Agrostis stolonifera latifolia* occurs, in a natural state, only on rich old pasture land; *Agrostis stolonifera angustifolia* occurs in moist woods, and on damp, clayey soils; *Agrostis stolonifera aristata* occurs chiefly or solely on moors and boggy grounds; *Agrostis stolonifera sylvatica* occurs only on light sandy soils, and particularly in places where these soils are shaded by wood; and *Agrostis stolonifera palustris* occurs chiefly, or almost wholly, in the bottoms of ditches, and by the sides of rivulets. Each variety, too, is so fond of its peculiar kind of habitat, that, when artificially treated, it will either pine away, or work itself into soil and circumstances similar to those in which it is naturally found. These remarkable differences of habit and the no less remarkable differences in amount of nutritive produce, form better characteristics or distinctive marks of the varieties than any very observable differences in the structure of the plants. *Agrostis stolonifera latifolia* flowers about the second or third week of July, and ripens about the second or third week of August; and when grown upon peaty soil, it yields per acre when in flower 17,696½ lbs. of green produce, 7,742 lbs. of dry produce, and 967¾ lbs. of nutritive matter,—and when ripe 19,057½ lbs. of green produce, 8,575¾ lbs. of dry produce, and 1,042½ lbs. of nutritive matter.

The name *agrostis* is derived from a Greek word which signifies 'a field,' and it was used

by the ancient Greeks as a general name for every kind of grass. The total number of species of true *agrostis* known to botanists is not fewer than about one hundred and ten. The species which we have noticed, are selected and named according to Sinclair's *Hortus Gramineus Woburnensis*; but the species which figure in Loudon's *Encyclopædia of Plants*, as grown in England in 1829, are the silky, *spica-venti*,—the broad-leaved, *retrofracta*,—the sea-side, *littoralis*,—the fine, *vulgaris*,—the hispid, *hispida*,—the fiorin, *stolonifera*,—the marsh, *alba*,—the whorl-flowered, *verticillata*,—the wood, *sylvatica*,—and the reedy, *calamagrostis*; and the species, dried specimens of which are exhibited in the museum of the Highland and Agricultural Society of Scotland, are *alba*, *calamagrostis*, *canina*, *capellaris*, *dispar*, *rupestris*, *spica-venti*, *stolonifera*, and *vulgaris*. The *spica-venti* and *verticillata* are annuals; the *stolonifera*, *alba*, and *littoralis*, are creeping-rooted; the *retrofracta* is a native of New Holland, and was introduced to Great Britain in 1806; and the *verticillata* is a native of the south of Europe, and was introduced to Great Britain in 1800. In Italy and the south of France, the stolons of several species of *agrostis* are gathered by poor persons on the road-sides and along the foot of hedges, and sold in small bundles in the market places as provender for horses. A tribe or family of grasses, in the modern Jussieuan arrangement, takes the *agrostis* for its type, and comprises the genera *muhlenbergia*, *chæturus*, *lagurus*, *polypogon*, *gastidium*, *agrostis*, *trichodium*, *tristegis*, *sporobulus*, *airopsis*, *cinna*, *spartina*, *psamma*, *crypsis*, *cornucopia*, *alopcurus*, *phleum*, *achnodonton*, *chilochloa*, and *phalaris*.—Sinclair's *Hortus Gramineus Woburnensis*.—Sproules' *Treatise on Agriculture*.—Transactions of the Highland Society.—Doyle's *Practical Husbandry*.—Richardson's *Essay on Fiorin*.—Loudon's *Encyclopædia of Plants*.—Catalogue of the Highland Society's Museum.—Lawson's *Agriculturist's Manual*.

AHL. See LIQUID MANURE.

AILANTHUS,—popularly *Tree of Heaven*. A small genus of very elegant exotic trees, of the Turpentine family. Four species are known to botanists; and two of these, the Chinese and the Indian, have been introduced to Great Britain. The Chinese species, *Ailanthus glandulosa*, is a remarkably beautiful ornamental tree, with one-leaved, five-parted, very small calyx,—acute, five-petaled, convolute corolla,—and a singularly elegant leaf, resembling that of the deciduous, pinnate-leaved sumach. It is a native of China, and was but recently introduced to Great Britain; yet is as hardy as any of our oldest or best known ornamental trees. It possesses surpassing beauty of foliage; and though later in coming into leaf than almost any other hardy tree, it compensates this fault by its extraordinary gracefulness. It grows rapidly, and attains a height of about fifty feet. It is easily

propagated from suckers, from cuttings of the root, and from foreign seeds; and the last ought, immediately on their arrival from China, to be sown, under protecting glasses, in boxes of light earth or of sand and peat. Some remarkably fine specimens of aïlanthus are growing on the Duke of Northumberland's grounds at Sion; and numerous specimens of it, from 30 to 40 feet in height, may be seen in many parts of England. Its timber is hard, heavy, and glossy, bears some resemblance to satin-wood, and is susceptible of the finest polish.

AIR. The gaseous fluid which constitutes the great bulk or pure portion of the atmosphere, and which forms an essential aliment of both animal and vegetable life. Every known gaseous fluid, from about the middle of last century till quite a recent period, was chemically called an air; and the gaseous fluid of the atmosphere, in order to be distinguished from other gases, was called *atmospheric air*. The principal airs known to the chemists of the last generation were vital air, or empyreal air, or dephlogisticated air, now called oxygen; phlogisticated air, now called nitrogen or azote; nitrous air, now called nitric oxide and deutoxide of nitrogen; dephlogisticated nitrous air, now called nitrous oxide and protoxide of nitrogen; inflammable air, now called hydrogen; fixed air, now called carbonic acid; and alkaline air, now called ammonia.

The atmospheric air—the only body to which the name *air* is now with any propriety applied—consists of oxygen and nitrogen, in the proportion of one atom of oxygen and two atoms of nitrogen, or of two grains of oxygen and seven grains of nitrogen, or of one cubic inch of oxygen with four cubic inches of nitrogen. This proportion—which we have thus stated in the three forms of atom, weight, and volume—is usually represented in the form of 20·82 per cent. of oxygen, and 79·16 per cent. of nitrogen. A wonderful fact—beautifully illustrating both the wisdom of the Creator and the benign care of his government—is that this proportion, so far as has been ascertained, prevails in all parts of the atmosphere,—that, in spite of the enormous consumption of oxygen in the processes of breathing, combustion, putrefaction, oxidation, and acidification, a universal provision exists for restoring volumes of it equal to the quantities consumed,—that notwithstanding the vastly greater consumption of it in some places than in others, an universal agency is in operation for maintaining the fair balance, or the equal diffusion of it in all localities of the earth and at all heights in the atmosphere,—and that, in defiance of an abundant and irregular ascent of ammonia, carbonic acid, miasmata, and other poisonous matters from almost all parts of the material surface of the world, chemical and meteorological appliances are everywhere at work to prevent these matters—except in small localities for the punishment of human filth, or indolence, or wickedness—from

so accumulating as either to alter the air's composition or to impair its vital action. Yet though the air itself, or pure air, never and nowhere sensibly varies in the proportions of its constituent oxygen and nitrogen, it is universally subject to two admixtures, and locally liable to numerous deteriorations, which more or less modify its power over vegetables and animals. Carbonic acid is generally mixed with the air in the proportion, by weight, of about one part to a thousand; and this ingredient is, on the one hand, continually abstracted or drunk up by plants for assimilation into a main ingredient in their bulk, and is, on the other hand, as constantly evolved from numerous processes and degrees of animal and vegetable combustion and decay; and wherever, from want of ventilation or from confinement of the processes which evolve it, or from enormous local disproportion between these processes and those which consume it, or from any other causes kept in operation by the folly or carelessness or sin of man, it is allowed to form any considerable local accumulation, it totally overpowers the salubriousness of the air, and proves most noxious to every kind of animal. Watery vapour is everywhere suffused through the air, usually or averagely in the proportion, by weight, of about one part to an hundred; and the increase or the diminution of its quantity very sensibly affects the weight and the other mechanical conditions of the air, and modifies its action considerably on animals and very greatly on vegetables. These two substances, carbonic acid and aqueous vapour, are so universally present in the air, and so uniformly coactive with it in its agency, as to be often considered as belonging to its constitution; and they really are extraneous to it, or must be considered as foreign matters, chiefly on account of their proportions being fluctuating while those of the oxygen and the nitrogen are uniform. But the deteriorating substances which rise into admixture with the atmosphere, directly from the presence of animals, from the crowdedness of human population, and from the filthy habits, the manufacturing processes, the culpable negligence, and the wicked conduct of man, are, in all respects, foreign substances; and by a singular law which strongly illustrates the doctrine of a moral providence—they have power to become less or more noxious or fatal almost exactly—perhaps quite exactly—in the degree in which they arise from the animal corruptibility or from the moral delinquency of man. Thus, ammoniacal gases, which arise merely from animal decay, however large a proportion they bear to the air in large cities, seldom of themselves exert any noxious influence, but, on the other hand, contribute largely to the most valuable processes of vegetation; while the miasmata which arise in company with the ammoniacal gases from scenes of filthiness and carelessness, the exhalations which ascend from stagnant ponds and undrained marshes, and the gases

and malaria which originate in conditions of territory produced by human guilt or by processes of manufacture rendered necessary by human folly and wickedness, almost constantly diminish the air's healthy power over both vegetables and animals, and often become concentrated into the very virus of epidemic and pestilential diseases. Air, or pure air, is the constant gift of the Divine bounty; and impurity of air is the product, directly or indirectly, of man's sin.

The necessity of ventilation, or of constant or at least frequent accession of pure air to confined apartments occupied by man or by inferior animals, is now so well understood that it does not need to be explained. Almost every farmer knows—and certainly every farmer ought to know—that animals shut up in a house send off large volumes of effluvia which require to be carried away, and consume large quantities of oxygen which require to be renewed,—and that, in consequence, both his family and his live stock will maintain vigour of vital action, and escape languor and feebleness and disease, exceedingly much in the proportion in which all the houses of the farmery are kept sweet and balmy by constant or frequent circulation of fresh air.—Nor is the necessity of a constant ventilation of soil, or of the circulation of fresh air through its pores and mimic channels, less urgent in order to the vigorous germination of seeds, or the healthy growth of plants. A calculation has been made that a properly pulverized and porous soil is occupied with air throughout one-fourth of its whole bulk; that, therefore, every imperial acre of land, duly tilled to the depth of eight inches, contains beneath its surface 12,545,280 cubic inches of air; and that every additional inch in depth of tillage achieved by thorough ploughing, brings into activity, upon each imperial acre, 235½ tons of soil, and brings into play within that soil, for the uses of vegetation, 1,568,160 additional cubic inches of air.—The comparative purity of the air, too, just as truly as temperature, exposure, or climate, affects the health and even the vitality of plants through the medium of their leaves. Some plants languish and others die in the atmosphere of a crowded city, while both flourish in uncontaminated air in the neighbouring country; some languish and others die in the midst of plains affected with malaria, while both flourish in the freer circulation of neighbouring hills and slopes; some languish and others die amid such bituminous and sulphurous exhalations as those of the shores of the Dead sea, while both flourish in the unmedicated air of the neighbouring districts; and some languish and others die amid the attenuated air of an alpine elevation, while both flourish in denser air of the same temperature in valleys or upon plains. In the air of London, alpine plants scarcely ever produce flowers, snow-drops die away, privets and china roses exist in health during only a short time, and so hardy and accommodating a tree as the

laburnum continues in perfect health during only a few years; and yet, in that air, most bulbous and tuberous rooted plants, the sycamore, the elm, the ivy, the oriental plane, the vine, and the mulberry, grow freely and prosper. See articles AERATION, AIR-CELLS, AIR-PLANTS, ATMOSPHERE, GASES, OXYGEN, AZOTE, HYDROGEN, AMMONIA, and CARBONIC ACID.

AIRA—popularly HAIR-GRASS. A genus of grasses of the bromus tribe. They are distinguished by their aquatic habits, and by the attenuated, filamentous, hairy form of their leaves. They flower from the first week till the third week of July, and ripen from the beginning till the end of August. They are very far inferior to some other grasses, both in the bulk of their green produce and in the quantity of their nutritious matter; and even if they were intrinsically deserving the attention of the farmer, they are, in a great measure, rendered unfit for field culture by their aquatic habits. Yet they possess sufficient features of interest to demand from us a comparatively full notice. The species of them, examined and analyzed in connexion with agricultural inquiry, are four in number, and bear the designations of *Aquatica*, *Cristata*, *Cæspitosa*, and *Flexuosa*.

Aira aquatica, or water hair-grass,—now sometimes called *Catabrosa aquatica*, or water food-grass,—grows naturally on the margins of pools and in the mud of slowly running water, but is easily and profitably cultivated on imperfectly drained fens. It is said to contribute much to the fine quality of the Cambridgeshire butter; and it has been pronounced by Mr. Curtis the sweetest of the British grasses; yet it is excelled, in the proportion of sugar to other nutritious matters, by the grasses *Glyceria fluitans*, *Poa aquatica*, *Elymus arenarius*, and *Poa nemoralis angustifolia*. It flowers in the second and third weeks of July; and when grown on mud covered with water, it yields per acre when in flower 10,890 lbs. of green produce, 3,267 lbs. of dry produce, and 382½ lbs. of nutritious matter.

Aira cristata, or crested hair-grass—called by the older botanists *Poa cristata* or crested meadow-grass, and now sometimes called *Koeleria cristata* or crested koeleria—is plentiful in some districts upon dry pastures, and may be cultivated as easily and successfully as *Festuca ovina* on any kind of dry soil; but it thrives best, and remains permanent, on moist and clayey lands. It is neglected by cattle so long as they can obtain *Lolium perenne*, *Cynosurus cristatus*, *Festuca ovina*, *Hordeum pratense*, *Avena flavescens*, or even *Aira flexuosa*; but the cause of their dislike to it seems to be, not its taste or composition, but the soft, hairy character of its foliage. It differs little in nutritious power from the grasses which cattle prefer to it; and approaches nearest to *Aira flexuosa*, but has a smaller proportion of bitter extractive matter, and a greater proportion of tasteless mucilage. It flowers about the first week of July, and ripens

about the first week of August; and when grown on sandy loam, it yields per acre when in flower 10,890 lbs. of green produce, 4,900½ lbs. of dry produce, and 340½ lbs. of nutritious matter,—and when in seed, 6,806½ lbs. of green produce, 3,403 lbs. of dry produce, and 127½ lbs. of nutritious matter.

Aira caespitosa, tufted hair-grass or hassock-grass—now sometimes called *Deschampsia caespitosa* or tufted Deschamps' grass—delights in wet, clayey soils, which abound in surface water, but occurs in almost every variety of pasture land, and forms dense tufts of hard, stiff, worthless herbage, which farmers designate hassocks and bull-faces, and justly regard as a pest upon their fields. Though not inferior to several decidedly useful grasses in either the bulk of its produce or the proportion of its nutritious matter, it has so harsh and wiry a texture as to be totally unfit for cultivation; and it sums up nearly all its interest in the bad fame of annoying farmers with its 'hassocks,' and being a troublesome and stubborn weed. Some farmers attempt to extirpate it, by digging up the hassocks, and filling their place with lime compost; some, by cutting down the hassocks in a series of frequent mowings; and some, by shaving it clean, and depriving it of its early shoots in spring. But eventually the most profitable cure, and by far the most effectual, is the thorough draining of the land,—accompanied, if the clay be very stiff, by such georgic treatment as will create some porosity in the soil. *Aira caespitosa* flowers about the third week of July, and ripens toward the end of August; and when growing upon clayey land, it yields per acre when in seed, 10,209 lbs. of green produce, 3,318 lbs. of dry produce, and 319 lbs. of nutritious matter.

Aira flexuosa, zigzag hair-grass or wavy mountain hair-grass, prefers a deeper though not a richer soil than *Festuca ovina*, and naturally grows among furze, while *Festuca ovina* grows among heath; yet it frequently occurs intermixed with that grass; and it forms a very suitable ingredient in a mixture of artificially sown grasses, for the second-rate improvement of heathy and furzy lands. Its produce on a heathy soil is double of its produce on loam. It flowers in the first week of July, and ripens in August; and when grown on heathy, clayey land, it yields per acre when in flower 10,209½ lbs. of green produce, 3,318 lbs. of dry produce, and 319 lbs. of nutritious matter,—and when ripe, 9,528½ lbs. of green produce, 3,573½ lbs. of dry produce, and 297½ lbs. of nutritious matter.

The total number of species of *Aira* known to botanists is about thirty; and the most interesting of these to British agriculturists, additional to the four we have noticed, are the following: *Aira lavigata*, smooth-sheathed hair-grass, indigenous on the lofty mountains of Scotland; *Aira trandata*, Pennsylvanian hair-grass, a native of North America, introduced to Britain in 1819;

Aira media, intermediate hair-grass, a native of the south of Europe, introduced to Britain in 1820; *Aira pulchella*, pretty hair-grass, a native of Spain, and an annual, introduced to Britain in 1820; *Aira caryophyllea*, silvery hair-grass, an annual, and indigenous in sandy pastures in Britain; *Aira canescens*, grey-panicked hair-grass; *Aira præcox*, early-flowering hair-grass; and a newly discovered and unnamed species, quite recently introduced from Van Dieman's Land. But only about eighteen of the species are retained in the genus by the most recent systematic botanists; and several of those we have named, as well as some others, are assigned to newly erected genera, or rearranged among old genera, in classifications founded upon minute and obscure characters.—*Sinclair's Hortus Gramineus Woburnensis*.—*Loudon's Encyclopædia of Plants and Hortus Britannicus*.—*Catalogue of the Highland Society's Museum*.—*Treatise on Husbandry in Lib. of Useful Knowledge*.

AIR-CELLS OF LACUNÆ. Cavities containing air, in the leaves, stems, or other parts of plants. In water plants, particularly in the *Fuci*, they are distinct and large, and consist of small and very regular vesicles of cellular tissue; and when cut open and examined by the microscope, they are, in many instances, seen to possess surpassing beauty. Their design seems to be to make the plants float. In terrestrial plants, or such as do not float, they are of more infrequent occurrence, much less definite in form, and of totally unknown use. Familiar examples of them are the chambers in the pith of the walnut-tree, and the tubes or cylindrical cavities in the stems of the garlic, the bamboo, and the British grasses. Their form in the genus *Equisetum* is not a little remarkable: a chief cavity occupies the centre of the stem; a series of smaller cavities occur round this in a circle; another series, larger than the preceding, and alternating with them, occurs round them in a second circle; and the whole constitute a cavitous group of very singular symmetry and beauty. The name air-cells, however, is not at all an appropriate designation; for it suggests the idea of cells similar to those of the cellular tissue, and at the same time denotes gaps, spaces, and cavities of widely different form and character,—tubercles, cylinders, hollows, and lacerations,—some wholly occupied with air, and others partitioned into a series of chambers. Yet "where spaces containing air, and communicating with the stomata, occur in the parenchyma of the leaves, as we learn from the observations of M. Ad. Brongniart that they often do occur, as in the case of floating leaves, there the appellation of air-cells may, perhaps, be sufficiently appropriate."

AIRING. Exercising saddle, carriage, idle-draught, or invalid horses in the open air. When conducted with moderation, and adapted to the condition of the animals' health and the nature of their feeding, it prevents swelling in the limbs,

improves the tone of the stomach, strengthens the lungs, and promotes the general health.

AIROPSIS. A small genus of exotic grasses of the *Agrostis* family, but taking the name of *Airopsis* from its close resemblance to the genus *Aira* of the *Bromus* family. Seven species are known; two of these, the short-leaved and the agrostis-like, have been transferred from the genus *Aira*; and three, the handsome, the globose, and the obtuse-leaved, have been introduced to Great Britain within the last twenty years. All are perennial and hardy; but they are either quite uninteresting to the farmer, or at best but curious.

AIR-PLANTS. Plants which can live suspended in the air, independent of soil, and drawing all their nourishment from the gases and the moisture of the atmosphere. They require, of course, to be supported by some suspending object, but they derive from it only a mechanical use, and do not, like lichens and fungi, treat it as a source of nourishment; and though they have the power of living by suspension, they sooner lose their energy, or exist during a considerably shorter time, than if they were supported and partly nourished by the soil. All are natives of very hot countries, and belong to the two tribes *Bromeliaceæ* and *Orchideæ*. The moss-like *Tillandsia usneoides* grows in festoons upon the branches of trees in the moist districts of tropical America, and the sweet-smelling *Tillandsia xiphioides* adorns the balconies of houses in Buenos Ayres; but these—which are the chief Bromeliaceous air-plants—have hitherto not been cultivated in this country. Even Orchideous air-plants—though they comprise many hundreds of beautiful species, and though they have of late years become somewhat common in the hot-houses of good florists—were, at a recent period, regarded in Europe as distant and almost fabulous wonders of the East, and even yet are far from being properly understood by many gardeners and amateurs who have attempted their cultivation. The most conspicuous genera are *Aerides*, comprising about eleven species, *Vanda*, comprising about six species, and *Sarcanthus*, comprising about five species; and the first of these, as their name implies, are the type of the whole air-plant tribe. “The true species of this genus,” remarks Mr. Loudon in his *Encyclopædia of Plants*, “are beyond all comparison the most delightful productions of the vegetable world. Their flowers are arrayed in long spikes or racemes of delicate colours and delicious fragrance. Hung up in a room in their native country, a little before flowering, they continue to unfold their blossoms in gradual succession for many weeks.” The air-plants naturally abound in the damp, hot, shady forests of the torrid zone of both the old world and America, hanging on the branches of trees, clinging to rocks, or creeping among moss, by the side of fountains or close to the spray of waterfalls; they occur principally in

Brazil, Peru, Mexico, the West Indies, Madagascar, Nepaul, and the whole of the Indian archipelago; they have been found, to the amount of three hundred species, in the single island of Java, and are described as there overmatting the trees by thousands, and combining with huge climbers and gigantic grasses to maintain among the forests a perpetual dampness and gloom; and when artificially cultivated in the hot-houses of Britain, they require a high temperature, a shaded or gloomy light, an exceedingly moist atmosphere, a dry position for their roots, and, above all, an annual season of repose. The neglect of the last of these requisites, far more than the neglect of any of the others, has hitherto occasioned them to languish or die with numerous cultivators. But if a fair proportion of gardeners will keep them growing during two-thirds or three-fourths of the year by means of heat, shade, moisture, and perfect drainage—and will throw them into repose during the remainder of the year, by withdrawing from them nearly all the moisture and most of the shade—air-plants of surpassing beauty and exquisite fragrance may soon become the gorgeous and delicious ornaments of our dwellings,—suspended from the ceilings, and diffusing clouds of odours, as they have long done in the houses of the Chinese. See **AERATION and ORCHIDÆ.**

AIR-VESSELS. Vegetable vascular organs, supposed by some vegetable physiologists to be employed in the inhalation of air. The spiral tubes of plants are regarded by most physiologists as vessels for conveying sap; but they were supposed by Drew and Decandolle to possess some slight resemblance in structure to the tracheæ of animals, and presumed to be used like these organs for the conveying of air. But air seems to have free access to the leaves and to other parts of plants quite independently of the spiral tubes; and strong reasons exist for concluding that Drew's and Decandolle's opinion of these vessels is unsound. See article **VASCULAR ORGANS.**

AJUAPAR—botanically *HURA*. A small genus of tender, evergreen shrubs or small trees of the euphorbia family. Only two species, *Crepitans* and *Strepera*, are known; and both are natives of South America and the West Indies. The *Ajuapar* is remarkable for its milky-looking juice of poisonous quality. It was found in the Spanish West Indies, and introduced thence to the British American colonies; and about eighty or ninety years ago, it became pretty common in the superior class of English gardens. It was originally called by Hernandez *Arbor crepitans*; and it afterwards received the popular names of the sand-box-tree, and the Jamaica walnut-tree. It acquires a height of twenty-four feet in the West Indies, but of only twelve or fourteen in England. Its stem is ligneous but soft; its branches are numerous, scarred, and very juicy; its leaves are heart-shaped,—the largest eleven inches long and

nine inches broad; its male flowers issue from between the leaves, on foot-stalks three inches long, and form a close spike or column, lying over one another like the scales of fishes; the female flowers grow at a distance from the male flowers, and exhibit a long funnel-shaped tube, spreading at the top, and divided there into twelve reflexed parts; and the seed-vessel is a compressed, ligneous capsule, divided by deep furrows into twelve cells containing each one large, round, compressed seed,—and when the capsule is ripe, it bursts with elastic force, flinging the seeds to a distance, and making the peculiar explosive sound which procured for the plant the specific designation of *Crepitans*. The *Ajuapar*, from the great size and the fine verdure of its leaves, constitutes a beautiful variety in a collection of tender shrubs; and when kept warm, and duly watered, it retains its leaves and its verdure throughout the year. Its capsules were early used by the West Indians to contain sand for writing; and hence the name of sand-box-tree. But the eminent and, at the same time, fearful property of the plant is its abounding in a very poisonous juice, which possesses the appearance and some of the qualities of milk. This juice is used to poison the water of rivers, in order that large quantities of fish may be killed and obtained; and when recently drawn from the plant, it produces very pernicious effects, resembling the symptoms and pains of erysipelas, by its mere exhalations, upon persons examining it, or remaining for a few hours in the same house in which it is placed. "This vegetable sap," says M. Boussingault, "would perfectly resemble that of the cow-tree, if it were not slightly yellowish. It has no smell; its taste, which is very little marked at first, soon causes very violent irritation. It reddens the colour of turmeric; mineral acids produce in it a white and viscous curd; the surrounding fluid is clear and of a yellow colour. Left to itself, the milky sap of the *Hura crepitans* yields all the products of the putrefaction of caseum. It contains an azotised substance similar to gluten or caseum, a vesicating oil, a crystallized substance having an alkaline reaction, malate of potash, nitrate of potash, a salt of lime (the malate?), and an odorous azotised principle." [*Boussingault's Rural Economy*.]

ALABASTER. A fine and beautiful kind of white stone, either carbonate of lime or sulphate of lime, used for ornamental purposes. The alabaster box of the ancients contained perfumed unguents; and seems, in many instances, to have been manufactured from the stalactitic and stalagmitic stones of spar caves. The perfumes deposited in the box, as in the case mentioned in the history of our Redeemer, were often "very precious," and were usually employed in the honourable anointing of the head of guests. The alabaster of modern times is seldom or never understood to include either stalactitic matter, white marble, or any other form of carbonate of lime; but is identified with the finest and purest

lithological specimens of gypsum. This is too fine and costly for the farmer's purposes,—differing widely from the common, coarse kinds of gypsum,—semi-transparent, snow-white, easily worked into vases and other ornamental articles, but rarely occurring in sufficient masses or of sufficient hardness to be used in statuary. The best is found in Tuscany; and some rather good sorts occur in Derbyshire and Staffordshire, and are there manufactured into toys and small ornaments. See GYPSUM.

ALATERNUS,—botanically *Rhamnus alaternus*. A number of varieties or sub-species of evergreen shrubs or small trees of the *Rhamnus* or buckthorn family. They appear to the unpractised eye to have closer connexion with the genus *Phillyrea* and the genus *Ligustrum* than with that to which they really belong; and though only sub-species, they present, to an ignorant or a careless observer, as broad apparent differences among themselves as those which occur among plants of totally unconnected genera. Miller treats them as constituting a genus of themselves; not a few nurserymen have confounded some of them with the genus *Phillyrea*; and a very general popular opinion assigns to some or all of them the names of blotched phillyrea, mock-privet, and evergreen privet. Any eye, however, can at a glance distinguish them from plants of the phillyrea or mock-privet family by the alternate position of their leaves,—the feature, in fact, to which they owe their name; and any botanical observer instantly detects them to belong to a totally different genus, by the structure of their flowers. Their features of distinction from *ligustrum* or common privet are still more obvious.

Three principal sub-species of alaternus are cultivated,—the common, the broad-leaved, and the jagged-leaved. The common alaternus is remarkable for the number of its established and known varieties, and for the freedom with which, when raised from seed, it sports into new varieties. The chief of the old or long-established and distinctly marked varieties are the larger alaternus, the smaller alaternus, the gold-striped alaternus, the silver-striped alaternus, and the blotched-leaved alaternus,—the last very generally called the blotched-leaved phillyrea. The ordinary sorts of the common alaternus have oval, crenated, lucid-green, and very beautiful leaves; and in April they produce, in little clusters and from the wings of the leaves, greenish-coloured flowers, which are followed by berries. The variegated sorts not only display a pleasing diversity of colour during summer, but so singularly alter their appearance in winter that some are brown, others are red, and others are green on their shaded side and red on their sunned side.—The broad-leaved alaternus greatly excels in appearance all the varieties of the common alaternus; and it may either be kept down to the condition of an undershrub, or sent easily

aloft to the height of a soaring tree. Its leaves are more heart-shaped than those of the common alaternus, and have a fine, shining, strong verdure during both summer and winter.—The jagged-leaved alaternus differs widely in appearance from the others, yet is a good-looking, straight-growing tree. Its bark is smooth and fine in summer, and assumes a reddish hue in winter; and its leaves are long, lanceolate, smooth, shining, and with peculiar and strongly-charactered serratures. Some variegated sorts of the jagged-leaved alaternus, with silver and gold stripes, are exceedingly beautiful, but so unconstant and fitful that, unless they receive peculiar culture in the worst kind of hungry soil, they will lose their stripes and revert to plain green. Numbers of other varieties of alaternus might be named, but they agree so nearly with some of the main varieties as not to be worth separate notice. Several varieties of the common alaternus were, at one time, in great favour for hedges and for planting against walls and out-buildings to conceal deformities and make an ornamental appearance; but they were found to be far too troublesome, and in other respects unsuitable,—and by a revulsion of fashion, they went totally into disrepute. All the sorts grow well in a dry gravelly or sandy soil. Plants intended for hedges or under-shrubs should be raised from layers; and plants intended to assume a tree-like form should be raised from seed,—and the latter, if their leading shoots be encouraged, will grow to a height of 18 or 20 feet.

ALBINO. A Spanish word applied to individuals of the human race who have the skin and hair white; the iris very pale, bordering on red; and the eye so sensible that they cannot bear the light of day. This condition is seen more frequently in the negro.

The *Albino*—called *Blafard* on the continent of Europe; *Bedas*, *Chacrelas*, or *Kakerlaks*, in India; *White-Negro* or *Dondos*, in Africa; *Darien* in America—is an individual malformation or degeneration in the colouring matter of the skin and hair, usually dying with the individual, but sometimes becomes hereditary, and is transmitted to their offspring. It presents the same characters in whatever race it appears, and is found likewise among the lower animals.

The human Albinos are of a feeble constitution, the skin of a dull white, the eyes weak with the iris red, and the hair of a pale yellow. They are most commonly found, or at least are most remarked, among the races of dark complexions. At Java, they are reported to form a wandering and proscribed race, roaming in the woods under the name of *Chacrelas*. Labillardière observed an Albino female of Malay descent upon one of the Friendly Islands. The Albinos of Ceylon, called *Bedas* or *Bedos*, appear to belong to the Hindoo race. They are also found among the Papoos; and have been seen, but very seldom, among the Hyperboreans. A white negress from

Madagascar was observed by M. Bory de St. Vincent; she had two children, the one by a white, the other by a negro. Each of these children presented intermediate characters between its parents, having the usual traits of the father combined with the Albino features and white hair of the mother. Albinos are reported to be common in the woods of the Isle of France. They are also common on the continent of Africa. In America, the most remarkable are the Dariens, who reside in the isthmus connecting the northern and southern portions of that continent.

The want of colour, or *albinism*, in animal and vegetable bodies, when they are said to be *leucæ* or *white*, has its proximate cause in the original want, or the diminished secretion, of the coloured layer of mucous net-work placed immediately under the epidermis, or outer skin of animals. With plants, this is owing to the inert secretion of the green matter, or chromule, and its ceasing to colour the cuticular tissues. In all species, softness and moisture are the results of this albinism or whiteness. Its ultimate cause is the want of vital energy, arising either from the prolonged absence of the influence of light upon the organic structure, or from the intensity of a long-continued cold. Its effects may be either absolute and total, or merely partial and local, even among the white varieties of animals and plants. Its general tendency is to effeminate all beings.

Accidental albinism may arise from old age, or the want of a continued renewal of this coloured layer, which communicates its hue to the hair, feathers, or scales. It may be even induced before old age by disease, or by the absence of the usual supplies of nutriment, or, among animals, by the violence of fear or any sudden emotion, which may serve to withdraw from the exterior of the body its secretions, and render the skin pale, or the hair white. There is also an accidental albinism from the mechanical injury of the mucous pigment, arising from the bruising or tearing of the skin, and on these spots, white hair or feathers will arise in the place of coloured appendages.

An opposite state of deep blackness, or *melanism*, when the surface is said to be *melanæ* or *black*, arises from the superabundance of the mucous subcutaneous tissue in animals and plants, in which carbon exudes towards the exterior. Such are negroes, and all black or dark-brown animals, lurid and venomous plants, as the *Solanæ*. This state of the skin is well-fitted for skies, resplendent with light and heat. It is attended in individuals with dryness, rigidity, and shortness of stature. Excessive cold, combined with the absence of light, serves to drive the nutritive and repairing juices far from the skin. This kind of albinism is especially remarked in animals inhabiting the highest mountains and the polar regions, where they become white in winter and coloured in summer. The large species of the porcupine exhibit these alternate annulations of

white and brown, which are due to the alternations of summer and winter. A similar effect might be produced on live sparrows, by plucking the feathers, and rubbing their naked bodies with spirit-of-wine. The feathers which then succeed remain white, because the alcohol prevents the secretion of the colouring subcutaneous matter, in the same manner as an excessive cold. A corresponding effect may be produced by similar means upon the mammalia.

ALBINUM. Cotton weed.

ALBUMEN. A constituent principle of organized bodies, nearly identical with the white of eggs. It is one of the most common and important of the substances of animals, and abounds in both their fluids and their solids. It forms a chief and essential part of the blood; it is a principal ingredient in the fluid which moistens the internal cavities and organs of the body; it constitutes the grand principle infused into the system by the nourishing portions of both animal and vegetable food; it abounds in the bones, the muscles, the glands, the membranes, and the skin; and it forms the principal part of nails, hair, horns, and cartilage. It is much less abundant in vegetables than in animals; yet it occurs in the green feculent matter of almost all plants, in the young shoots of trees, in the juices of almonds and other emulsive seeds, and in the pervading sap of a considerable proportion of plants; and it exists in large quantity in all vegetable substances which are most nourishing as food, and in all such vegetables as ferment without yeast, and furnish stimulating drinks of the nature of cyder, ale, or wine, such as the seeds of all gramineous plants. Its properties, as it exists in animals and in vegetables, or in the several individuals of the two kingdoms, are believed to be perfectly uniform. Its composition, according to the analysis of Gay-Lussac and Thénard, comprises, in every 100 parts, 52·883 of carbon, 23·872 of oxygen, 15·705 of nitrogen, and 7·540 of hydrogen. By other analyses it has been represented as containing

	By experim.	Atoms.	By calcul.
Cf carbon,	54·84	400	54·70
hydrogen,	7·09	310	6·92
nitrogen,	15·83	50	15·84
oxygen,	31·23	120	21·47
phosphorus,	0·33	5	0·35
sulphur,	0·68	2	0·72

Its grand feature of interest to the farmer is its containing so large a proportion of nitrogen; for it is this feature which identifies it with the nutritious quality of the best kinds of vegetable produce, and makes it an exponent of the intimate or rather necessary connexion which exists between the cultivation of the cereal grasses and the sustenance of man and the lower animals in a civilized condition of society. See article Azote.

The white of an egg consists of albumen held in solution by a little water, and combined with a very small portion of salt; and it may, for every

practical purpose, be regarded as a specimen of pure albumen, and applied to albuminous uses. This substance exhibits the remarkable character of possessing one set of properties as a fluid, and of being convertible from a fluid to a solidified condition, and possessing a totally different set of properties as a solid. If a quantity of the fluid be placed in an open vessel, it will speedily putrefy, or begin to resolve itself by decomposition into its elements; but if a small portion of it be spread out in a thin layer, and subjected to a current of dry air, it will solidify into a hard, transparent substance like horn, and will be as durable or unchanging in its new form as the claws of a bird or the nails of a man. When any portion of the fluid is, in any manner, acted on by a certain degree of heat, it undergoes a kind of solidification, which is peculiar to itself, and bears the name of *coagulation*, but which is of too unique and subtle a nature to be as yet understood by chemists. The coagulation commences, at a heat of about 134° of Fahrenheit, by the formation of filiform or fibrous streaks; it proceeds, at a heat of about 160°, to the conversion of the entire fluid into a thick elastic paste; and it terminates, at a heat of 212°, in the compression of the whole into a dry, shrunk, hard mass of almost the appearance of horn. In the proportion in which the white of egg is diluted with water, a higher degree of heat is required to effect the successive degrees of coagulation. Albumen is also coagulated, but with somewhat different appearances and results, by alcohol, vitriol, aquafortis, hydrochloric acid, the various metallic salts, and galvanic action. Fluid albumen is easily soluble in cold water; but coagulated albumen is as insoluble as horn. The white of egg is an excellent clarifier of liquids, and an effectual antidote to the virulent poison of corrosive sublimate, by decomposing the chloride of mercury. Peschier states that one egg is required for every four grains of the poison. It is also an antidote against poisonous preparations of copper, such as blue vitriol and verdigris. See GLUTEN.—*Philosophical Transactions*, vol. xc.—*Ure's Dictionary*.—*Liebig's Chemistry*.—*Keith's Botanical Lexicon*.

ALBUMEN. An organ or organic substance in the seeds of many kinds of plants. A pulpy matter, in which the embryo of seeds is first developed constitutes the rudimental albumen, and occurs in all seed-producing plants; but, in some plants, such as the turnip, the pea, and the bean, this is gradually and at last totally absorbed as nutriment by the growing seed, and in others, such as cocoa-nut, the castor-oil plant, and the cereal grains, it is developed and hardened into a permanent albumen, which either performs the most important services in the process of germination, or is subservient to economical purposes of the highest value. Thus, the albumen of the cocoa-nut is both the meat and the milk of that fruit; the albumen of the cereal grasses furnishes the flour of grain; the albumen of the castor-oil

plant furnishes the castor oil of medicine; and the albumen of the plant *Theobroma* furnishes the well-known chocolate and cocoa of the grocery.

ALBURNUM,—popularly **SAPWOOD**. The newest formation of woody matter in trees, or the soft ligneous layer between the duramen and the liber,—between the portions popularly called the timber or heart-wood, and the bark. It is formed by the deposition of the cambium or elaborated sap between the alburnum of the former year and the bark; it consists wholly of vegetable tissue, and serves, while in the state of alburnum, as the chief channel of the sap's ascent from the root to the leaves; it continues in the state of alburnum only till a new layer of deposition be made by the cambium; and it then becomes increasingly harder and denser, and of a duller and deeper shade of colour, till, in the course of a year, it totally ceases to be sapwood, and possesses the character of the outer layer of duramen or heartwood of the tree. The vegetable tissues, or soft vascular organs which constitute it, are wholly occupied, during its alburnous period, with the circulating sap, but serve, when it is becoming heartwood, for the reception of hard, inert, and immoveable secretions. The alburnum, in its true state of sapwood, is, in consequence, soft and very perishable; but when converted into duramen or heartwood, is hard and comparatively durable. The vascular organs, so long as occupied with circulating sap, and constituting alburnum, are technically said to be living; but when deprived of circulating sap, and occupied with inert secretions, and constituting with these secretions duramen or heartwood, they are technically said to be dead. Some timbers, such as those which are known in commerce as the timbers of white-wooded trees, contain exceedingly little secretitious matter, and are therefore almost wholly alburnous, and extremely soft and perishable. But most timbers have the alburnum and the duramen very distinct from each other; and the harder sorts display them in visibly different colours, and with tangibly different hardness. Logwood and ebony have their alburnum of a very light grey colour, and their duramen black or deep red; the eagle-tree, *Aquilaria mallaocensis*, has its alburnum black and its duramen of a lighter colour; and most other trees have their alburnum white, and their duramen of various shadings from the creamy-white of some of the pines to the deep tints of mahogany and rosewood.

ALCALI. See **ALKALI**.

ALCHEMILLA. See **LADIES' MANTLE**.

ALCOHOL,—popularly *Spirits of Wine*. The stimulating and intoxicating substance of wine, ale, gin, whisky, rum, brandy, and similar fermented and distilled liquors; in other words, the pure spirit obtainable by distillation from all liquids that have undergone vinous fermentation. It has so very powerful an affinity for water, that it usually exists in a state of great

dilution, and cannot be obtained in a state of tolerable rectification except by repeated distillations and other chemical processes. The ardent spirits or liquors are mixtures of 54 per cent., or less, of alcohol with water and volatile oil. But by mere distillation alcohol cannot be freed from water beyond a certain point of from 10 to 15 per cent. Hence it is necessary to distinguish between absolute alcohol and the alcohol of commerce. When of the strongest quality, or as free from water as it can be obtained, it has a specific gravity of 0.7947 at 59°, or 0.792 at 64°, and 0.739 at its boiling point; but as sold by distillers, or even as usually found in the laboratory of chemists, it has seldom a less specific gravity than .837. The most common forms of alcoholic liquor are those of gin, whisky, rum, and brandy,—the first and second obtained by distillation from malted barley or other grain, the third from the juice of the sugar-cane, and the fourth from the juice of the grape; and all usually contain from 40 to 60 per cent. of water, while each derives its peculiar flavour from extractive or oily matters in the vegetable substances subjected to distillation. According to experimental analyses conducted by Professor Brande on various wines—some of which, however, as prepared for the London market, would be highly 'brandied'—every 100 parts of Port wine contains from 21.40 to 25.83 of alcohol; of Madeira wine, from 19.34 to 24.42; of Sherry, from 18.25 to 19.83, but Dr. Prout's analysis of very old Sherry, gave 23.80; Claret, according to Brande, 12.91; Calcavella or Carcavellos, 18.10; Lisbon, 18.94; Malaga, 17.26; Bucellas wine, 18.49; Red Madeira, 18.40; Malmsey Madeira, 16.40; Marsala wine, from 17.26 to 25.87; Red champaign, 11.30; White champaign, 12.80; Burgundy, from 11.95 to 14.57; White hermitage, 17.43; Red hermitage, 12.32; Hock, from 8.88 to 14.37; Vin de grave, 12.80; Frontignac, 12.79; Cote rotie, 12.32; Roussillon wine, 17.26; Cape Madeira, 18.11; Cape Muschat, 18.25; Constantia, according to Prout, 14.50; Tent or Tinto, according to Brande, 13.30; Sheraz, 15.52, but White Sheraz, according to Prout, yielded 19.80; Syracuse, according to Brande, 15.28, but Prout states Aetna or Syracuse at 30, so that it would appear these analysts used different wines in some instances under the same name; Nice, according to Brande, 14.63; Tokay, 9.88; Raisin wine, 25.77; Grape wine, 18.11; Currant wine, 20.55; Gooseberry wine, 11.84; Elder wine, 9.87; Cyder, 9.87; Perry, 9.87; Brown stout, 6.80; Buxton ale, 8.88; Edinburgh ale, 6.20; Brandy, 55.39; Rum, 53.68; Hollands, 51.60; Scotch whisky, 54.32; and Irish whisky, 53.90.

Alcohol, according to the analysis of MM. Saussure, Duflos, and Dumas, consists of 12.896 per cent. of hydrogen, 52.65 of carbon, and 34.454 of oxygen; or, according to analysis tested by the atomic theory, it consists of three atoms of hy-

drogen, two of carbon, and one of oxygen. Sugar consists of exactly the same elements, but in different numbers of atoms; and when resolved into these elements by the process of fermentation, all the hydrogen, two-thirds of the carbon, and one-third of the oxygen, of every nine atoms of the sugar reunite to form alcohol, while the remaining atom of carbon and two atoms of oxygen unite to form carbonic acid, and disappear in impalpable and invisible gas. An obvious inference is, that beet-root, carrot, potato, rice, or any other vegetable which naturally contains sugar, may, by subjection to fermentation, or to similar processes as malted and distilled barley, be made to produce alcoholic liquors. But the grand use which the farmer ought to make of the fact, is sedulously to guard against any saccharine substance running spontaneously or through negligent treatment into fermentation, aware that if it do, all its highly nourishing sugar will be destroyed, one part of it to mingle gaseously with the atmosphere, and another part to become a useless, disgusting, and perhaps noxious liquid.

Alcohol, nearly free from water or other intermixture, is a limpid, colourless liquid, with a strongly spirituous smell, and an exceedingly pungent taste. It does not freeze at a temperature 123° below the freezing point of water, nor possibly at a considerably lower temperature; it is exceedingly volatile, and very considerably cools the portion of air into which it evaporates; it suffers a greater degree of expansion from heat than water does; it burns with a lambent flame, yielding no smoke and little light, but intense heat; and it mixes readily and in any proportion with water, and gives out heat during the process of commixation. Alcohol dissolves resins and many similar substances which are unaffected by water, and these solutions are termed spirit-varnishes; it draws out and dissolves the extractive matter in seeds, roots, and other parts of vegetables, and hence is extensively used in the preparation of tinctures; it dissolves with great facility, and holds retentively in solution, camphor, and all the essential oils; it combines with sulphur and phosphorus; it forms a large and important material in the preparation of various kinds of ether; and it dissolves ammoniacal gas, soap, sugar, and various acids, as the tartaric, the benzoic, the gallic, and the oxalic. Partly on account of these extensive solvent powers, and partly for sake of various influences which it exerts, and offices which it performs as a chemical reagent, and a modifier of chemical affinity, it is very extensively employed by the varnish-maker, the perfumer, the adulterator of wines, the commercial chemist, the druggist, and the apothecary.

The general effect of all wines and distilled drinks is to stimulate and excite the energies of the system, and, in larger quantities, to produce intoxication, and consequent debility and de-

rangement of all the functions. This property, which is common to them all, depends upon the alcohol or pure spirit which they contain. By it the faculties of the mind, as well as the functions of the body, are at first roused into more vigorous exertion;—the blood is made to circulate with greater rapidity, an agreeable glow is diffused over the whole frame, the senses are enlivened, the passions awakened, the imagination becomes sportive, and joy and gladness fill the soul. But this agreeable paroxysm soon passes away; and the mind and body are left in a greater state of depression and languor than before. We speak not here of the last stage of brutal intoxication, nor the series of degrading symptoms which mark its progress,—as vertigo, maniacal fury, or fatuous delirium, faltering tongue, tottering limbs, apoplectic insensibility!—death itself! It is enough to observe, that the habitual abuse of intoxicating drinks, even within the limits of what is commonly deemed sobriety, is equally destructive to the health of body and mind; and that a frightful catalogue of diseases, gout, apoplexy, and palsy, madness and fatuity, are commonly the consequences of greater excesses. As powerful stimuli, ardent spirits are, in some cases of languor and debility, advantageously employed; but their properties ill fit them for common and habitual use. Nothing is more pernicious than the practice of drinking spirits. It is a common enough belief, that a dram after meals promotes digestion; but there cannot be a more erroneous opinion. Those, indeed, who have acquired this pernicious habit, may find that, without their usual stimulus, digestion goes tardily on. But this only bespeaks the infirm and diseased state to which the stomach has been reduced. For the digestion of the healthy and unaccustomed is sure to be interrupted and retarded by a dram. Common observation may satisfy us of this. But the question has been submitted to direct experiment by Dr. Beddoes, and he found that the animals to whom spirits had been given along with their food, had digested nearly one-half less, than other similar animals from whom this stimulus had been withheld. Who, indeed, are so subject to stomach complaints as dram drinkers? They are not only the most liable to ordinary and occasional stomach complaints, but too commonly to permanent and incurable diseases of that important organ. The stimulant and intoxicating properties of vinous and fermented liquors also depend upon the alcohol, or pure spirit which they contain; when used to excess, they are therefore liable to all the objections we have urged against the abuse of distilled spirits. But, as in the fermented vinous liquors, the alcohol is not only much diluted, but in a peculiar state of combination with other principles, with the vegetable acids, sugar, mucilage, and extractive matter, they are much less destructive and pernicious than any of the distilled drinks. They

are also more digestible, and considerably nutritive.

Some veterinary surgeons are known to give fatigued horses doses of alcoholic carminatives; and some grooms, quite as consistently, give such horses liberal doses of downright whisky or gin. Such monstrous practices will be regarded by the next generation of men with mingled wonder, pity, and derision. Administered internally, alcohol, as every one knows, is a stimulant and excitant. Externally, it is sometimes useful as a styptic to restrain hæmorrhage from its property of coagulating the blood, and at the same time causing contraction of the bleeding parts. In burns and scalds when the skin is not removed, and in sprains and bruises, it acts usefully. It is further useful as an antiseptic. In case of poisoning by spirituous liquors, the most effective remedy, after evacuation of the stomach, is a solution of acetate of ammonia.—*Thomson's Chemistry*.—*Ure's Dictionary*.—*Liebig's Chemistry*.—*Edinburgh Pharmacopœia*.—*Magazine of Domestic Economy*.—*Dunghison's Therapeutics*.

ALDER,—botanically *ALNUS*. A genus of hardy, amentaceous trees of the birch tribe. It was formerly included in the genus *Betula* or Birch; but is easily distinguished from that genus by its having only four stamens and wingless fruit; and it has very properly been treated by all recent botanists as a separate genus. The principal species are the common alder, *Alnus glutinosa*; the hoary-leaved, *A. incana*; the broad-leaved, *A. macrophylla*; the Siberian, *A. Siberica*; the saw-leaved, *A. serrulata*; the bearded, *A. barbata*; the wave-leaved, *A. undulata*; the glaucous or smooth, *A. glauca*; the red, *A. rubra*; the dwarf, *A. pumila*; the denticulated, *A. denticulata*; the Mexican, *A. jorullensis*; and the heart-leaved, *A. cordifolia*. But the species *incana* includes two well-defined varieties, called the winged and the angular-leaved; and the species *glutinosa* includes seven very distinct varieties,—the silver-striped, *A. glutinosa foliis argenteis*,—the emarginate, *A. g. emarginata*,—the cut-leaved, *A. g. incisa*,—the hawthorn-leaved, *A. g. oxyacanthifolia*,—the jagged-leaved, *A. g. laciniata*,—the oak-leaved, *A. g. quercifolia*,—the oblong-leaved, *A. g. oblongata*,—and the elliptic-leaved, *A. g. elliptica*. Yet both the common species, and two or three others of the best known species, sport with such freedom and frequency, that very numerous varieties might be selected. Several of the species have been quite recently discovered and introduced, and are very little known; four or five belong to Europe, and all the rest to America; and, excepting some varieties of the common species, nearly the whole group of alders are untested for economical purposes, and have hitherto been grown only for ornament or from curiosity.

The common alder (*Alnus glutinosa*), is very generally diffused and known throughout Britain. It usually occurs only as a shrub; but,

when permitted to grow to maturity, it is a tall, massive, and stately tree. Its bark, in the shrubby state, is purplish and smooth; but, in old trees, is blackish and much chopped. Its leaves are clammy to the touch, dark green in colour, roundish in shape, nicked on the margin, and somewhat like those of the hazel. The footstalks of the leaves are about an inch in length; and the leaf-ribs, like those of the lime-tree, have spongy balls at the angles of their under side. The female catkins are conical, and the male catkins cylindrical; and the latter appear in autumn, and remain till spring. The alder naturally grows in swamps and meadows in almost every part of Europe and of North America, and in a large proportion of Asia and of northern Africa; yet though a very decided aquatic, it does not thrive in stagnant water, but prospers best on the banks of streams, or on elevated and drained parts of marshy land. From its large and abundant foliage, its deep and glowing verdure, and its tendency to acquire a decidedly good and even picturesque outline, it is well fitted for cultivation as an ornamental tree; yet it suffers grievous damage in popular opinion from accidental association, and, except when very lofty and in a particularly fine situation, is liable to be scouted as vulgar and disagreeable,—“an ugly melancholy tree,” as Boutcher has it. Most persons have seen it only in low, dreary, dirty situations, dwarfish in stature, deformed by accidental fractures, or hacked and disfigured by the hatchet; and they cannot easily imagine how beautiful and noble it becomes, when cultivated with proper care, or even when treated with mere forbearance. Many fine specimens of it adorn some of the best parks in Great Britain; and thousands of both its shrubs and its trees enrich not a few of the most exquisite river landscapes of at once the quiet, the luscious, the romantic, and the grandly imposing character. An alder belonging to Mr. Beevor, and growing in his garden, measures upwards of 16 feet in circumference at four feet from the ground. Several very fine alders are noticed by Mr. Marshall as growing in the old part of Stowe Gardens, and a truly ornamental one as growing by the road thence to Buckingham. On the Earl of Carlisle's estate in Cumberland, there is an alder tree which, at three feet above the ground, is more than nine feet in circumference. Some very large alders, looking in the distance like oaks, grow in the Bishop of Durham's park at Bishop-Auckland; some in the Duke of Northumberland grounds at Sion-house; and some in the grounds of Gordon-castle in Banffshire. Three of those in the last of these places are described by Joseph Sabine, Esq., in the Transactions of the London Horticultural Society; and when examined by him, they measured in circumference at five and six feet from the ground respectively 9½, 7½, and 8 feet, and had a height of respectively 70, 61½, and 58 feet. “He who would see

the alder in perfection," remarks Mr. Gilpin, "must follow the banks of the Mole in Surrey, through the winding and delightful vales of Dorking and Mickleham, into the groves of Esher. The Mole, indeed, is far from being a beautiful river; it is a silent and sluggish stream; but what beauty it has, it owes greatly to the alder, which everywhere fringes its meadows, and in many places forms very pleasing scenes, especially in the vale between Box-hill and the high grounds of Norbury-Park."—"In very many instances," says Mr. Gilpin's commentator, Sir Thomas Dick Lauder, "we have seen the alder put on so much of the bold resolute character of the oak, that it might have been mistaken for that tree, except for the intense depth of its green colour. The Mole may doubtless furnish the traveller with very beautiful specimens of the alder, as it may also furnish a specimen of quiet English scenery; but we venture to assert, that nowhere will the tree be found in greater perfection than on the wild banks of the river Findhorn and its tributary streams, where scenery of the most romantic character everywhere prevails."

The alder has suffered a very unwarrantable degree of disrepute, not only as an ornamental plant, but as a coppice-shrub and a timber tree. In some of the oak coppices of the Scottish Highlands, it is considered a nuisance, occupying more space than it is worth, and is relentlessly exterminated to make room for oak and ash. In some other places and situations, in which it has established itself without help from man, it is treated as a very unwelcome intruder; and in numberless situations where it might be planted, either with profit from itself or with important advantage to grounds or to other trees, it is utterly neglected. Yet it grows freely in a great variety of soils, from the marshy and boggy to the dry, the sandy, and the elevated; it is far from being fastidious as to position or troublesome in cultivation; it readily accommodates itself to a variety of circumstances as a plant, and fitly serves a variety of purposes as timber; and, when all its qualities and adaptations are fairly considered, it is far worthier of attention than some trees which possess pretty general favour. In many low damp situations, it makes the best live fence which can be reared; for there it grows freely and with vigour, while thorn or almost any other hedge plant would be feeble and stunted, or would sicken and die. In maritime situations, as on swampy grounds along a low sea-board, it thrives well, and forms an excellent screen. On the sandy, loose, frangible banks of streams, it excels every other plant for binding the ground into a strong natural embankment, and for converting an unsightly and perishable stretch of channel into an ornamental and permanent line of water-course; for it sends numerous and ramified series of roots along the edges of streams in search of

food,—and, by their multiplicity, their length, and their intricacy, it interlaces and binds the soil into a well-woven and compact mass. In wet sour lands which are unfit for any other timber, and cannot be profitably reclaimed, it might be profitably grown for even the most common purposes of brushwood. In very exposed situations, in consequence of its very rapid growth, and of its great power of resisting storms, it might be very advantageously raised for the nursing and sheltering of more valuable trees. Along the margins of swamps, or athwart the face of any blotched and disagreeable section of landscape, if it were planted in groups, and allowed sufficient room to assume a tree-like character, and permitted to grow to maturity without the application of the knife or the hatchet, it might completely hide the unseemliness of the ground, and convert a moor or a morass into a pleasant-looking object, and at the same time grow up with a fair remunerative reference to its ultimate availableness as timber. Yet the aquatic habits of the alder deprive light soil of all moisture, and render it exhausted and barren; its roots render almost any soil more moist, spouty, and rotten-looking than before they occupied it; and its suckers and seedlings exert a mischievous and almost poisoning influence upon herbage. The alder, therefore, ought not to be grown in any pasture field, upon any good land, or in any other situation in which dryness of soil and healthiness of grass are considerations of importance.

The economical uses of alder, in its foliage, its bark, and its timber, were at one time of more moment than at present, yet are still both numerous and valuable. Its trunks were formerly in prime and universal request for water-pipes, drains, pump-trees, and conduits to reservoirs; but have been almost wholly superseded by pipes of lead, tin, and iron. Its timber is well-suited for subaqueous piles, and for most descriptions of subaqueous woodwork, "where it will harden like a very stone," says an old writer; yet may now be regarded as superseded for even these purposes by the kyanized wood of more close-grained trees. A cross section of the timber shows the large primary rays of the duramen, thinly arranged, yet in nearly regular order,—the secondary rays slender, numerous, and interrupted,—the cells of the concentric rays nearly regular,—and the spaces between the rays crowded with cells. The timber, therefore, ought to be well-suited for the cogs of wheels and other parts of wooden machinery, for the wooden heels and soles of shoes, and for various descriptions of turnery; and it has, at times, been used in considerable quantity for each of these purposes. Charcoal made of its timber has long been highly valued for the manufacture of gunpowder. Its largest roots and the knotty parts of its stem are often beautifully veined, and form a good material for cabinets. The bark and the young shoots yield a yellow

dye, and a basis for black colours. An ounce of the pulverized bark, with an ounce of logwood, six grains of the solution of copper, six grains of the solution of tin, six grains of the solution of bismuth, and two drops of the solution of sulphate of iron, boiled in three-fourths of a pint of water, dyes a strong deep *boue de Paris*. The shoots, when cut in March, dye a fine cinnamon colour; and, when dried and pulverized, dye a handsome drab. The bark is also used by leather-tanners, leather-dessers, and the tanners of nets. The leaves are refused by swine, but eaten by horses, cows, sheep, and goats; but they blacken the tongues of horses, and they are of a very astringent nature, and probably quite unwholesome to be used, in even small quantities, as forage.

The alder, like most native aquatics, is very easily propagated. It may either be raised from seed,—though this method is seldom practised in Great Britain,—or propagated from truncheons, suckers, cuttings, or layers, of three, four, or five years' growth. The method by truncheons is peculiar, and is noticed as follows by Evelyn, and called by him the Jersey manner: "I received it from a most ingenious gentleman of Jersey: it is, to take truncheons of two or three feet long at the beginning of the winter, and to bind them in faggots, and place the ends of them in water till towards the spring, by which season they will have contracted a swelling spire or knur about that part, which being set does never fail of growing and striking root." The truncheons are suspiciously spoken of by Hanbury and Marshall, and are shown by Mr. South, in the 'Bath Papers,' to be at least in some instances delusive; but they are favourably regarded by other writers; and when tried, they ought to be planted in February or March, two feet deep in loosened soil, and afterwards kept free from weeds. Layers seem much the best method for securing success, and are certainly far the best for perpetuating varieties; and they ought to be laid in October, kept laid till the following October, and then planted 18 inches deep, and deprived of their top to about nine inches from the ground.—The leaves of the alder are subject to the depredations of a small beetle, with dark, violet-blue, shining wing-cases, and called *Chrysomela betulae*; and they are also liable to be pierced and devoured by the caterpillar of a saw-fly which has its designation from them, and is called *Selandria alni*.

The cut-leaved variety of the common alder, *A. g. lanciniata*, is a plant of uncommon beauty, especially when young; it grows as rapidly and attains as large a size as its type; and it is pre-eminently fitted for the purposes of an ornamental tree in moist and low situations. The hawthorn-leaved variety, *A. g. oxyacanthifolia*, is of feebler habit than its type; but it combines elegance with singularity, has deeply-lobed leaves like those of the hawthorn, and possesses remarkably little resemblance to the other varieties of the alder. The oak-leaved variety, *A. g. querci-*

folia, is of smaller growth than its type. Some of the other varieties are of quite shrubby habit, and cannot be made to assume the form of trees.—The species *incana* or hoary-leaved alder—also called Turkey alder and upland alder—is distinguished from the common alder by the greater erectness of its attitude, by the hoariness of the under side of its leaves, by its freedom from glutinosity or clamminess, by its greater rapidity of growth, and by its capacity of attaining a larger size. Yet its varieties, like those of the common alder, are very numerous, and, in several instances, quite dwarfish. This species, while it is believed to possess all the good properties of the *Alnus glutinosa*, has the accommodating and valuable one of perfect adaptation to light dry land, away from either ditch, marsh, or rivulet.—The heart-leaved alder of Calabria, *Alnus cordifolia*, grows with great rapidity, has deep-green, shining leaves, deeply heart-shaped at the base, forms a rather large and very handsome round-headed tree, differs considerably in appearance from both *Alnus glutinosa* and *Alnus incana*, is one of the most elegant and interesting trees recently introduced to Great Britain, and, though a native of the sunny climes of Southern Italy, is perfectly hardy. The Mexican alder, *Alnus jorullensis*, is a beautiful species, very recently introduced; and has large, oval, acuminate leaves, prominent in their veins, and downy on their under side.—The indented or denticulated elder, *Alnus denticulata*, is also a quite recently introduced species, and was sent from Russia, its native country, by Dr. Fischer; and it grows with vigour and rapidity, is perfectly hardy, and has very large and somewhat indented leaves.—The American species are believed to be inferior to the common alder in the economical value of their bark and timber; and the other species, which are comparatively new to British cultivators, have hitherto been tested or appreciated in no other property than that of giving variety to the effects of foliage in plantations.—*Loudon's Encyclopædia of Plants*.—*Marshall on Planting*.—*Bath Letters and Papers*.—*Nicol's Planter's Kalendar*.—*Miller's Dictionary*.—*Gilpin's Forest Scenery*.—*Transactions of the L. Horticultural Society*.—*Doyle's Practical Husbandry*.—*Sir John Sinclair's General Report of Scotland*.

ALDER (BERRY-BEARING),—botanically *Rhamnus frangula* and *Rhamnus alpina*. Two species of berry-bearing shrubs of the buckthorn genus. The frangula, or plain berry-bearing alder, comprises the principal varieties, the common black, the dwarf, and the American smooth-leaved. The common black berry-bearing alder grows naturally in the woods of England; and is, sometimes ignorantly, sometimes knavishly, confounded with *Rhamnus catharticus*, the medicinal buckthorn. It attains a height of about ten feet, rises with an upright stem, and sends out on all sides a profusion of branches. Its bark is smooth, of a bluish colour, and so dappled all over with white

spots as to have the tint of a bluish gray. Its leaves are oval, spear-shaped, about two inches long and one inch broad, growing irregularly on the branches, their upper surface smooth and of a shining green, and their under surface possessing many strong veins which run from the midrib to the edges. Its flowers are greenish, very small, unexpanding, and very unobscure; and they are produced in clusters, on every side of the branches, at the first and second joints of young shoots, and at the end of the shoots of a former year. The berries are red while growing, and black when ripe; and are very ornamental to the plant. The flowering occurs in June, and the ripening in September. This plant makes a favourable figure in the writings of herbalists, but is really of very trifling medicinal value. Its berries used often to be sold in the markets of London for the berries of buckthorn; but they may easily be distinguished by their possessing only two acini or seeds, while the berries of buckthorn possess four.—The dwarf berry-bearing alder seldom rises higher than two feet; and makes no show in either flowers or berries, the former being small, and the latter rarely ripening or even developing. Its branches are of a bluish brown colour; and its leaves are nearly circular, and stand on short footstalks, and have many strong veins running from their midrib to their border.—The American smooth-leaved berry-bearing alder attains the same height as the common berry-bearing alder, and differs very little from that variety in either leaves, flowers, or fruit.—The rough-leaved alpine frangula, or rough-leaved alpine berry-bearing alder, *Rhamnus alpinus*, attains a greater height than any of the varieties of *Rhamnus frangula*, is unarmed with thorns, and has doubly-lancinate and comparatively tough and large leaves. A variety of this species, called the smooth-leaved alpine berry-bearing alder, has smoother leaves and a taller habit than its type. All the sorts of frangula are easily propagated from seeds, sown in autumn.

ALDERNEY COW. See **CATTLE.**

ALE. A well-known beverage, produced by the fermentation of hops and malt in an abundant infusion of water.

Ale, either in its modern composition or of some more simple character, is supposed to have been invented by the Egyptians, and to have been suggested by the unsuitableness of their very fertile lands for the cultivation of the grape. Herodotus, who wrote upwards of four hundred years before the Christian era, says that the Egyptians used a liquor made from fermented barley. Dion Cassius makes allusion to the use of a similar liquor by the inhabitants of the sea-board of the Adriatic. Tacitus states that the ancient Germans drew a liquor from barley or some other grain, and so fermented it as to make it resemble wine. Pliny mentions that ale, under various names, was used by the Egyptians, the Spaniards, and all the nations of the west of Europe, and that

this beverage was made even by the inhabitants of some vinous countries. Ale was the favourite beverage of the Danes and the Anglo-Saxons, and a constant drink at their feasts; and while they continued in a heathen condition, they believed that copious libations of it formed one of the principal felicities of their deceased and immortal heroes. Ale is named in the laws of King Ina, and is recorded to have been used at a royal feast in the reign of Edward the Confessor. The grain for the manufacture of ale was treated by the ancient Britons and other Celtic nations almost precisely as it is treated by modern maltsters and brewers; for, according to the statement of Isidorus and Orosius, "it was steeped in water, and made to germinate, it was then dried and ground, and it was afterwards infused in a certain quantity of water, and fermented." Hops seem to have been introduced to the manufacture of ale, by the German and the Dutch brewers, about the year 1400; but they were prohibited to be used in England by a statute of the year 1530, they began to be raised in English hop-gardens about the year 1552, and they seem to have come into general use in England about the year 1600.

Ale, as is well-known, has, for a long period, been used as a beverage by the middle and the operative classes of the rural population of the greater part of England; and, in consequence, it is an object of very considerable economical interest to the large majority of English farmers.

Different kinds of ale are brewed, such as pale ale, brown ale, hop ale, herb ale, strong ale, and table ale; and various other kinds of malt liquor are closely akin in both constitution and mode of manufacture to ale, such as small beer, table beer, strong beer, and the different sorts of brown stout and porter. Pale ale is made from slightly dried malt, and is characterized quite as much by its viscosity as by its colour. Brown ale is made from thoroughly dried or half toasted malt, and has a close relation to strong beer or light coloured porter. Hop ale contains a very small proportion of malt, and is much less alcoholic and considerably more tonic than the pale and the brown ales. Herb ale is any ordinary ale medicated with gentian root, quassia wood, calamus aromaticus, or any other tonic bitter. Strong ale and table ale are distinguished rather by their comparative proportion of water than by their quality. The distinctions amongst ale, beer, and porter, are stated as follows by Dr. Thomson:—"Both ale and beer are obtained by fermentation from the malt of barley; but they differ from each other in several particulars. Ale is light-coloured, brisk, and sweetish; while beer is dark-coloured, bitter, and much less brisk. Porter is a species of beer, and is what was formerly called strong beer. The original difference between ale and beer was owing to the malt from which they were prepared. Ale malt was dried at a very low heat, and consequently was of a pale colour; while beer or porter malt was dried at a higher tem-

perature, and had in consequence acquired a brown colour. This incipient charring had developed a peculiar and agreeable bitter taste, which was communicated to the beer along with the dark colour. This bitter taste rendered beer more agreeable to the palate, and less injurious to the constitution than ale. It was manufactured in large quantities, and soon became the common drink of the lower ranks in England. When, during the wars of the French revolution, the price of malt was very materially increased, the brewers found out that a greater quantity of wort of a given strength could be procured from pale malt than from brown malt; the consequence was, that pale malt was, to a considerable extent, substituted for brown malt in the brewing of porter and beer. The wort now, however, was paler, and wanted that agreeable bitter flavour which characterized porter. The porter brewers endeavoured to remedy these defects by several artificial additions, such as burnt sugar, quassia, &c., and most of which the chief London porter brewers, I believe, long since discontinued."

The adulteration of ale and of all other malt liquors—contrary to Dr. Thomson's charitable supposition—continues to be practised in a most flagitious manner and to an almost incredible extent. In Scotland, genuine malt liquor, especially of the common or "small" kinds, is with difficulty obtained; and even in England, in spite of its general use and of the extensive practice of home-brewing, is very far from being general. "The statute," says Mr. Accum, "prohibits the brewer from using any ingredients in his brewings, except malt and hops; but it too often happens that those who suppose they are drinking a nutritious beverage, made of these ingredients only, are entirely deceived. The beverage may, in fact, be neither more nor less than a compound of the most deleterious substances; and it is also clear that all ranks of society are alike exposed to the nefarious fraud." Mr. Child, in his very widely circulated treatise on the brewing of porter, says that, however disagreeable or pernicious the ingredients used in adulterating malt liquor may appear, they seem to be indispensable for producing such taste, flavour, and body of beer as will secure the public favour. Some of the usual adulterating substances which have been the subjects of frequent detection and public punishment at the breweries, are of a harmless nature upon health, and deceive only the eye and the purse; but others are either powerful drugs or downright poisons, and cannot be employed by the brewer without enormous guilt in the sight of God, or consumed by the purchaser without certain damage to his health. Some of the most common of these substances are molasses, honey, burnt sugar, ginger, carraway-seed, coriander-seed, orange peel, gentian root, quassia, capsicum, grains of paradise, wormwood, liquorice juice, cocculus indicus, salt, alum, copperas, harts-horn shavings, mixed drugs, extract of cocculus

indicus, extract of poppies, tobacco, nux vomica, opium, and vitriol. Appalling as is this list of abominations and poisons, in too many instances swallowed by the drinkers of ale and porter, it would be incomplete without a statement of the proportion of alcohol contained in the various kinds of genuine malt liquor. Mr. Accum furnishes us with such a statement, partly on the authority of his own analyses, and partly on that of the analyses of Professor Brande; and he must be understood as giving the proportion not of proof spirit, but of rectified alcohol,—a substance which we saw in a former article to be about double the strength of ordinary brandy, whisky, or rum. According to this statement, home-brewed ale contains 8.3 per cent. of alcohol, Burton ale from 6.25 to 8.88 per cent., Edinburgh ale 6.2 per cent., Dorchester ale 5.5 per cent., common London-brewed ale 5.82 per cent., Scotch ale 5.75 per cent., London porter from 4 to 4.75 per cent., Brown stout from 5 to 6.80 per cent., and Small beer from 0.75 to 1.28 per cent.

The preparing of malt forms in this country a special avocation, and the cultivating of hops is confined by climate to the warm counties of the south of England and Ireland; yet both may, in certain circumstances, be conducted on a small scale by either the farmer or the cottager. The quantity of good beer assigned by Cobbett as sufficient for a labourer's family during the year is 274 gallons; this quantity of beer is produced from about 15½ bushels of malt, or about 12½ bushels of barley; and this quantity of barley may, in an average crop, be obtained from about three-fifths of a rood of ground. The barley for any one brewing, in order to be malted, may be put into a bag, and steeped for an hour in a tub of water; then taken out, laid in a heap on the floor of a warm room or corner, and covered with straw or with two or three bags to raise a moist heat and produce vegetation; and finally, when the growth from each grain is three-fourths of an inch in length, spread out to be dried either in an oven, or on a heating flue, or on the hottest part of the flued floor. Home-made malt, however, is sometimes manufactured in the easier method of grinding or bruising the fresh barley, mixing it with a small quantity of ground malt, and placing it for two or three hours in mash at a heat of about 150°. But the ale produced by malt manufactured in this manner is said to be strong and flat, to have a bad taste, to lie heavily on the stomach, and to be decidedly unwholesome. Seeds not fully ripe are usually found to vegetate sooner and more strongly than seeds which have been fully ripened; so that barley intended for malting ought to be cut down a few days earlier than barley for the pot. Wheat, barley, or other grain, when sprouted in the ear in consequence of wet weather, is very generally, on English farms, taken home, dried, and used as malt; and the seeds of ryegrass, when sprouted, might probably be very effectively used in the same manner.

Hops, when the climate is suitable, are easily grown. A cottager may either raise four plants on a square yard of ground, to climb four poles of twelve or fifteen feet in height; or plant five or six roots round an arbour; or so place several roots that a plant may climb each column of the rustic veranda of his cottage. The buck-bean plant or marsh trefoil, *Menyanthes trifoliata*, was formerly used as a substitute for hops in this country, and is still so used on the continent; it is easily cultivated in moist soil; and one ounce of its dried leaves is equivalent to half a pound of hops. All the plants of the same natural order as *menyanthes*, particularly the plants *Gentiana rubra*, *Gentiana lutea*, and *Gentiana purpurea*, might also be substituted for hops; and the roots of one of these, *Gentiana lutea*, are used in the distillation of a spirit in Switzerland. The dried roots of the herb-bennet, so common in the hedges of England, are sliced, enclosed in a thin linen bag, and suspended in the beer cask, by the brewers of Germany, to prevent the beer from turning sour, and to give it the flavour of cloves. A similar use—as we have already hinted when speaking of adulteration—is made of ginger, capsicum, orange peel, coriander-seed, caraway seed, and calamus aromaticus; and powerfully astringent bitter qualities might probably be extracted also from several plants of the genera *Agrimonia*, *Dryas*, *Comarum*, *Potentilla*, and *Tormentilla*; yet—to show how eminently dangerous it is to drug with even well-known herbs—the roots of the last of these genera, the plants of *tormentilla*, are so very powerfully astringent and constipating that the decoction of a few drachms of them, administered in a series of doses, has become a prescription of the highest medical practice for arresting the most violent diarrhoeal action of the bowels,—so that the ignorant use of any such astringent plants in domestic economy might be followed by consequences, not only detrimental to health, but hazardous to life.—*Child on Brewing*.—*Combrune's Theory and Practice of Brewing*.—*Thomson's Chemistry*.—*Accum on Adulteration of Food*.—*Anderson's Commercial Dictionary*.—See articles BEER and BREWING, HOPS, and MALT.

ALEHOOF—botanically *GLECHOMA HEDERACEA*. A well known creeping perennial plant,—called also turnhoof, ground-ivy, and gill-go-by-the-ground,—and formerly designated by botanists *Hedera terrestris*. It creeps under hedges, upon the sides of banks, at the foot of trees, and in most shady places, in almost every district of England; and it is powerfully stoloniferous, and forms a new root at every joint of its stems, in the same manner as strawberry plants. Its roots are fibrous; its flowers are blue, and appear in spring; and its leaves are roundish and notched, and become purple during the progress of the season. Alehoof was a chief ingredient in the manufacture of ale by the ancient Saxons; and it still continues to be occasionally used by the poor for infusion in ale or beer, as a remedy

against internal disorders. Herbalists—those clownish quacks and guilty tamperers with disease—assert that the plant heals wounds, both by outward application and by inward use; that a decoction of it, drank daily for a considerable period, cleanses the stomach, sweetens the blood, and promotes the healthy secretions; that a decoction or an infusion of it is a strengthening eye-water; that an infusion of it operates as a diuretic, and alleviates diseases of the lungs and chest; that applications of it are very strengthening to weak backs; that an ointment made from it heals ulcers and fistula; and that equal quantities of alehoof, daisies, and celandine, strained and used as an eye-wash, remove all descriptions of inflammations and ophthalmic sores.

ALGÆ. The large tribe of cryptogamic plants, which comprises the sea-weeds of the ocean and the small flowerless vegetable growths of fresh water. The name properly means *flags*, and originally designated plants or herbs growing in sea-water; but it has been extended by botanists to include all vegetables with frondose herbage, many of which are not even aquatics. But the very large family of Lichens, which have little resemblance to the rest of the tribe, and possess distinct characteristics and considerable importance of their own, have recently, with the general consent of the botanists of the present day, been detached from the algæ, and erected into a separate tribe. See LICHENS. Yet the algæ, even when freed from the incongruous association of the lichens, are exceedingly diversified, and cannot be comprehensively defined by any more minute characteristic than their frondose leafage. Some are visible to the naked eye only when they exist in heaps; and some are hard, strong leathery masses, many fathoms in length, and occasionally so luxuriant and multitudinous as to take entire possession of sections of the sea, and completely impede the course of ships. Any distinct root is either undiscoverable as a support for their fronds; or, when it does exist, as in the case of many of the fuci, it is merely a fibrous or scutate base, not for organic support or nourishment, but merely for mechanical attachment. Even the frond is far from being of uniform appearance in the different divisions of the tribe; for in the tremellinæ, it is gelatinous,—in the confervæ, it is thread-like and jointed,—and, in the fuci, it is leather-like and jointless.

Professor Agardh, in his work called '*Systema Algarum*,' defines the algæ as "aquatic plants destitute of cotyledons and of sexual organs; gelatinous, membranous, or coriaceous; filamentous, laminose, or even leafy; in colour green, purple, or olivaceous; jointed or continuous; bearing sporidiæ, either included in pericarps, or scattered over the surface;" and he divides them into the six sub-tribes of Diatomæ, Nostochinæ, Confervoideæ, Ulvaceæ, Floridæ, and Fucoideæ. The Diatomæ comprise six genera, and are bodies of various forms, flat, crystalline,

and separating into fragments. The Nostochinæ comprise eight genera; they are partly marshy and partly marine, and include an enormous number of individuals; and they are either globular or filiform, and are suspended in a gelatine of definite form. The Confervoideæ comprise thirty-one genera; they are partly parasitical on rocks or barks, extensively marine, and chiefly marshy, lacustrine, and ditchy; and they consist of threads or filaments, jointed either externally or internally, separate, and not combined in any definite form. The Ulvaceæ comprise six genera; their fronds are membranous, continuous, tubular, or flattened, but never ribbed or herbaceous, and very rarely purple; and their fruit is a heap of sporules, either naked, or forming scattered and covered granules. The Florideæ comprise eight genera; their frond is generally coriaceous or leather-like, and is either flat or filiform, unjointed, and of a pink or purple colour; and their spores have a purple colour, and are either enclosed in capsules or clustered in sori. The Fucoideæ comprise twelve genera; their frond is rarely membranous, generally leather-like, and always unjointed, olive-green, and either flat or filiform; and their spores are enclosed in capsules, which are either ovate and situated in a peculiar receptacle, or pyriform and immersed in the frond. In his quite recent work, 'Algæ Maris Mediterranei et Adriatici,' M. Agardh divides the Algæ into the six tribes of Ceramieæ, Cryptonemeæ, Chondrieæ, Rhodomeleæ, Sphærococcordeæ, and Delesserieæ.

A simpler and more comprehensive arrangement divides all the algæ into the disjointed, the jointed, and the jointless. The disjointed algæ occur on the stems of other plants, immersed in water, or floating in ponds and ditches; they consist of individuals which are composed of fragments, and have the power of self-multiplication simply by separating or throwing asunder their fragmentary parts; and they are considered by some naturalists as aggregations of minute animals, and certainly lie on the organic verge of the animal and vegetable world. The jointed algæ comprise many of the marine kinds and most of the fresh-water kinds; they always appear to the eye like series of little green threads; and they occur, in endless variety, in ditches, ponds, and running streams. The jointless algæ constitute the great bulk of the tribe; they comprise all the sea-weeds, and all the broad membranaceous algæ of both sea and fresh water; and they consist of roundish cellules, either firmly adhering to one another, or connected by masses of transparent gelatine. Dr. Greville enumerates, in 1830, 575 species of inarticulated algæ, whereof about one-fourth are British species. In his family Florideæ are included nearly a half of our British algæ; but it is the Fucoideæ, the Laminariæ, and the Ulvaceæ, which give the character to our marine vegetation. "The former, numerous in in-

dividuals, and very valuable, as from them kelp is principally made, occupy with their blackness all the space between low and high water-marks, living an amphibious sort of life, alternately exposed to the atmosphere, and covered by the tide. The Ulvæ and Porphyreæ intermix with them, and give some variety to the shore by their green and purple fronds. The Laminariæ occupy a lower zone, for they are strictly aquatic, and choose, therefore, a station not liable to be left dry at the reflux of the tide. With the exception of *L. debilis* and *latifolia*, the others are widely and generally distributed along our coasts, affording shade and shelter to myriads of creeping things, and becoming ultimately a source of profit to the agriculturist, to whom the '*Alga projecta vilior*' is an unintelligible comparison. The other families may be considered as subordinate; for, although many genera and species amongst them, as, for example, *Chordaria*, *Furcellaria*, *Desmarestia aculeata*, &c., are met with abundantly everywhere; and many others, though local, are plentiful enough, yet, from their smaller size, or their concealed stations, they make no material change on the appearance of the coast. 'It is easy to perceive,' says Dr. Greville, 'that some species, *Gelidium corneum*, *Phyllophora rubens*, and *Sphærococcus coronopifolius*, for example, become more plentiful and more luxuriant as we travel from north to south; and, on the other hand, that *Ptilota plumosa*, *Rhodomenia lycopodioides*, *Rhodomenia socolifera*, and several others, occur more frequently, and in a finer state, as we approach the north. *Odonthalia dentata* and *Rhodemia cristata* are confined to the northern parts of Great Britain; while the *Cystoseiræ*, *Fucus tuberculatus*, *Haliseris polypodioides*, *Rhodomenia jubata*, *R. Teedii*, *Microcladia glandulosa*, *Rhodomenia pinastroides*, *Laurencia tenuissima*, *Iridea reniformis*, and many others, are confined to the southern parts. Others, again, such as the Fuci in general, the Laminariæ, many Delesseriæ, some Nitophylla, Laurentiæ, Gastridia, and Chondri, possess too extended a range to be influenced by any change of temperature between the northern boundary of Scotland and the southwestern point of England.' The causes which influence the distribution of the algæ on a particular coast are not well known. Temperature is one; but there are many facts which the admission of this cause will not explain. 'A few yards is, in some instances, sufficient to create a change; and the space of three or four miles a very striking one;' not merely in regard to species, but in their luxuriance and rapidity of development. The nature of the soil, according to Dr. Greville, has here much influence. 'Thus,' says he, 'calcareous rocks favour the production of some species, sandstone and basalt that of others; and it would appear that the soil has an effect even upon those algæ which grow parasitically upon the stems of the larger species.'

The algæ, particularly the fuci, are of very

considerable economical value. *Laminaria saccharina*, *Halymenia palmata*, *Halymenia edulis*, and several other fuci, are eaten by many persons, and are much relished both raw and dressed. *Fucus lichenoides* appears to be the chief ingredient in the edible birds' nests which form so costly and so exceedingly esteemed an article of epicurism among the Chinese. Many kinds of the fuci are probably eaten by fish, and in consequence indirectly serve for the sustenance of land-animals and of man; some of the same great division of the Algæ have been extensively used in the arts, particularly in the manufacture of kelp and the preparation of dyes; and enormous masses of them are collected in many parts of the British coasts, and in every part of the coasts of Ireland, and used by farmers as manure. A great quantity of vegeto-animal matter is procured from sea-weeds, and they are the only things in which iodine, supposed to be one of the simple or primitive substances, has been found. As it is against the rules of sound reasoning to admit that iodine is created by the mere power of vegetation, so it is evident, that it must be derived from some extraneous source; although Messrs. Davy and Gaultier de Claubry have not been able to detect it in sea-water, and it has not been found by any analysis to be present in the soils on which sea weeds grow. In fact, the discovery of the origin of iodine still remains to be made. See articles FUCI and SEAWARE.—*Loudon's Encyclopedia of Plants*.—*Withering's Botany*.—*Keith's Botanical Lexicon*.—*Greville's Algæ Britannicæ*.—*C. F. B. Mirbel in Quarterly Journal of Science*, vols. v. and vi.

ALIMENT. Any substances which, being received into the bodies of organized beings, animal or vegetable, promote the growth, support the strength, and renew the waste of their systems. See the following article, also articles Food and Nutrition.

ALIMENTARY PRINCIPLES. The following extracts from Pereira's *Materia Medica* convey a sufficiently extended view of the subject. For details respecting the several substances, see the articles on them in the present work.

Dr. Prout has divided the alimentary principles into three great classes or groups—the *saccharine*, the *oleaginous*, and the *albuminous*, to which he has latterly added a fourth, the *aqueous*. He was led to this division by observing that milk—the only article actually furnished and intended by nature as food—always contains a saccharine principle, a butyraceous or oily principle, and a caseous, or, more correctly speaking, an albuminous principle.

CLASS 1. SACCHARINE PRINCIPLES. The principles contained in this class are SUGAR, GUM, PECTIN, STARCH, and LIGNIN: see these articles. These agree in being of vegetable origin, and in consisting of carbon, hydrogen, and oxygen. With the exception of pectin or vegetable jelly, they contain oxygen and hydrogen in the ratio

to form water; and might, therefore, be termed hydrates of carbon.

Those varieties of each principle which contain the smallest quantity of water, Dr. Prout terms *strong* or *high*; while those containing the largest proportion of water, he denominates *weak* or *low*. Thus, sugar-candy is a high or strong sugar,—sugar of starch, a weak or low one.

1. *Saccharine substances.* Under this head are placed several sweet organic principles, capable, for the most part, of undergoing vinous fermentation when mixed with yeast and a due proportion of water.

a. SUGARS SUSCEPTIBLE OF VINOUS FERMENTATION.

1. *Crystallizable.* This division includes common sugars, viz., cane, maple, and beet-roots sugars; granular sugars, viz., grape, honey, starch, and diabetic sugars; and sugar of milk.

2. *Uncrystallizable.* Known as liquid or mucous sugars, as treacle.

b. SUGARS UNSUSCEPTIBLE OF VINOUS FERMENTATION.

1. *Crystallizable.* Mannite.

2. *Uncrystallizable.* Glycyrrhizin, glycerin, and sarcocollin.

Sugar is a highly nutritious substance, and by the healthy stomach is readily digested. It appears to be especially adapted for the food of young plants; hence we find it generated in many seeds (as pease, barley, &c.) during germination. It is nutritive to animals. Thus it is an important constituent of milk,—a liquid intended for the nourishment of mammals during the first period of their existence. It is employed by man on account of its agreeable taste, rather than as a direct source of nourishment; yet, of its nutritive qualities few entertain any doubt. The injurious effects which have been ascribed to it are more imaginary than real. Some individuals have consumed large quantities of it, for a long series of years, without suffering any ill consequences.

2. *Mucilaginous substances.* The gummy principles, called arabin, tragacanthin or adraganthin, cerasin or prunin, cydonin, and bassorin, belong to this group. They possess nutritive properties, but are somewhat difficult of digestion. Hasselquist tells us, that a caravan of more than a thousand persons, travelling from Abyssinia to Cairo, and whose provisions were exhausted, supported themselves for two months on the gum they were carrying as merchandise. The Moors and the Negroes near the Niger employ it as a common kind of food. The Hottentots also are well aware of its nutritive properties.

3. *Vegetable jelly.* To this head are referred pectin or groussulin, and carrageenin. These are nutritive and digestible.

4. *Amylaceous, farinaceous, or starchy substances.* Under this division are included wheat-starch, sago, tapioca, arrow-root, potato-starch, salop,

&c. Amylaceous matter is found in various parts of plants. When cooked, amylaceous matter is a nutritious and easily digestible substance. Directly or indirectly, observes Dr. Prout, "it forms a constituent of the food of most of the higher animals, as well as of man. It differs, therefore, from sugar, in being a *necessary* article of food, without which animals could not exist; while sugar is not. Hence a much larger quantity of amylaceous matter than of sugar can be taken; and what is a still more decisive fact, the use of this larger quantity of amylaceous matter may be persisted in for an unlimited period, which, it appears, is not the case with a large proportion of sugar."

5. *Lignin* or *woody fibre*. "It forms," says Dr. Prout, "the appropriate food of numerous insects and of some of the lower animals, but of few of the higher classes of animals. The reason of this is probably to be sought for in their not being furnished with organs proper for comminuting and reducing it; for when lignin is comminuted and reduced by artificial processes, it is said to form a substance analogous to the amylaceous principle, and to be highly nutritious." The Laplanders, according to Linnæus, eat bark-bread during a great part of the winter, and sometimes even during the whole year. It is prepared from the inner bark of the *Pinus sylvestris*.

CLASS 2. OLEAGINOUS ALIMENTARY PRINCIPLES. This class comprehends the substances denominated fats, fixed oils, and butter. Oleaginous aliments are highly nutritious, but exceedingly difficult and slow of digestion. Sir John Ross is of opinion that the natives of cold countries seem to require a more fatty diet than the inhabitants of tropical regions, in order to promote the production of animal heat. See articles BUTTER, FAT, and OIL.

CLASS 3. NITROGENOUS ALIMENTARY PRINCIPLES. The most important alimentary principles, containing nitrogen, are fibrine, albumen, caseum, gelatine, and gluten. The animal extract, called osmazome, is also a nitrogenous principle. With one exception—gluten—these principles are obtained from the animal kingdom, and they have, in consequence, been frequently denominated *animal aliments*. See articles ALBUMEN, CASEUM, FIBRINE, GELATINE, GLUTEN, and OSMAZOME.

Fibrine is eminently nutritious, and easy of digestion. Albumen is highly nutritious, and when either raw or lightly boiled, is easy of digestion; but when boiled hard, or especially when fried, its capability of being digested is considerably impaired. Caseum is nutritious, and moderately easy of digestion. Gelatine, or animal jelly, is an exceedingly nutritive principle, though probably somewhat less so than fibrine and albumen. Gelatine from bones is employed in Paris for the preparation of a nutritious soup for hospitals and other pauper habitations. Confectioner's jelly is made from isinglass, calves' feet, and patent

gelatine. Soups and broths owe their nutritive properties principally to gelatine. Young meats yield more gelatine than old ones. To osmazome broths and soups owe their flavour, smell, and part of their nutritive qualities. Gluten is believed to be highly nutritious, and to confer on wheat flour its well-known superior alimentary qualities. "Its viscosity or tenacity," says Brande, "confers upon that species of flour its peculiar excellence for the manufacture of macaroni, vermicelli, and similar pastes."

The subject of aliment will be further discussed under the heads of ANIMAL FOOD, DIGESTION, FODDER, NUTRITION, &c.

ALISMA,—popularly *Water Plantain*. A genus of aquatic herbs, giving name to the natural order Alismaceæ. The most common species, *Alisma plantago*, the great water plantain, derives its specific name from the resemblance of its leaf to that of the common plantain, grows in wet ditches and by river sides in Great Britain, and has the reputation—we suppose an ill-founded one—of being a cure for hydrophobia. Four other well-known species have the popular names of spear-leaved, blunt-leaved, floating and lesser water plantainæ. The order Alismaceæ comprise three genera; and, as a whole, are handsome water plants, with white flowers,—natives of ditches in temperate countries, and within the tropics,—and eaten, in some instances, by the Chinese.

ALKALIES. Substances of opposite chemical properties to those of acids. They have a hot, acrid, bitter taste; they counteract or neutralize the sourness of acids, and all the effects which that sourness produces; and, in general, they possess the well-known properties of the ley of wood ashes. The name alkali is formed of the Arabic article *al*, and the Arabic word *kali*; the former used intensively like our prefix *super*, and the latter meaning the bitter substance, and used to designate the herb which we call glasswort, *Salicornia Arabica*. The Arabians burnt this herb to ashes, boiled the ashes in water, and procured, by evaporation, a white powder which they regarded as the concentration of the herb, and designated al-kali, the eminently bitter substance. This alkali is potash; and the name alkali is, in consequence, used by all British chemists and scientific agriculturists as the generic appellation of all the substances which resemble potash in their properties and action. All the alkalies, like potash, turn vegetable blues into green, convert vegetable yellows into reddish-brown, and restore such vegetable blues as have been turned into red by acids; and they can easily be detected by means of an infusion of turmeric, or an infusion of red cabbage, or of pieces of paper stained with either of these infusions. Yet the alkalies do not result from the action of any specific or alkalizing principles, but are very variously constituted.

The principal alkalies, or those which make the

most conspicuous figure in agricultural chemistry, are ammonia, potash, and soda. Ammonia is popularly called the *animal alkali*, because contained in animal substances; potash, the *land vegetable alkali*, because contained in land vegetables; and soda, the *sea vegetable alkali*, because contained in sea vegetables;—ammonia, the *volatile alkali*, because it naturally flies off in vapour; and potash and soda, the *fixed alkalies*, because, in all ordinary conditions, they resist evaporation. But these three principal alkalies require a little additional definition; and a large number of other alkaline substances require to be brought into view. Ammonia consists of hydrogen and nitrogen, is obtainable in a separate form only by chemical operation, exists naturally in the excretions, the urine, and the excrements of animals, evaporates into the atmosphere so as to mix gaseously with the air and in rain, and, even when artificially obtained, is usually met with only in such combinations as constitute liquids or salts. Potash and soda, though long supposed to be simple substances, and regarded as unique in both character and action, are now known to be metallic oxides; potash consisting of oxygen and a metallic substance called potassium, and soda consisting of oxygen and a metallic substance called sodium. Various other alkaline bodies are constituted in a manner precisely similar to potash and soda, and are designated alkaline oxides or alkaline earths. Lime, one of the most important examples of these, consists of oxygen and a metallic substance called calcium; and magnesia, another important example, consists of oxygen and a metallic substance called magnesium. Yet lime and magnesia, in this primary and proper sense of alkaline earths, must not be confounded with the lime and the magnesia of popular phraseology; for these are carbonates of lime and magnesia, and hold the alkaline matter of the earths in a state of dilution and alteration by chemical union with carbonic acid. Even the alkalinity of the true alkaline earths is far less active or powerful than that of potash and soda. Yet, with the exception of magnesia, all the alkaline earths, as well as potash, soda, and ammonia, are acrid to the taste, and have a caustic action on the skin. Another important class of alkaline substances exist as characteristic constituents of certain plants, are produced in these plants during the progress of vegetation, and bear the general designation of *alkaloids*, or *vegeto-alkalies*. They consist of various, yet in each instance, definite proportions of oxygen, carbon, hydrogen, and nitrogen; and yet though so very differently constituted from ammonia, they possess a considerable resemblance to that powerful and unique alkali in their alkaline properties and modes of chemical action. See ALKALINE BASES. Ammonia evaporates at a very low temperature, and is decomposed at a high temperature; potash, soda, and the other alkaline oxides resist the evaporating power of comparatively

high temperatures, and, though they may imbibe oxygen, are not decomposed by the action of heat in the open air; and all the alkaline bases or alkaloids are decomposed at high temperatures, and yield up their constituent elements to the formation of new compounds. All the alkalies readily combine with acids to lose their own alkalinity of action, to destroy the acidity of the acids, and to form new substances called alkaline salts; and ammonia and many of the alkaline oxides combine with metallic oxides—as ammonia with the oxides of cobalt, copper, and nickel, and potash and soda with silica, alumina, and the oxides of lead and zinc—to form another class of latently alkaline substances. The alkaline salts perform a part in the laboratory of the soil and in the chemistry of vegetation, second in importance only to the alkaline oxides themselves,—being readily decomposed by chemical forces which there attack them, and freely giving out their elements to act chemically upon the soil and alimentarily upon plants.

Argillaceous or clayey earth—such mineral matter as contains a proportion of alumina or the concentrated principle of clay—forms a component part of by far the greater portion of fertile soils; and in any rare instance in which it is absent from land capable of cultivation, some source, either natural or artificial, exists for the supply of its characteristic elements. Now the whole fertilizing power of this earth consists in its invariably containing alkalies and alkaline oxides, with sulphates and phosphates. Alumina exercises an influence on vegetation, not by chemical action upon accompanying earths, nor by mechanical control over the roots, nor by entering the organism of the plant, nor by forming an element in its substance, but by attracting and retaining water and ammonia, and by yielding up its potash or soda to exert their directly alkaline influence upon surrounding silicious matters in the soil, and upon the juices, secretions, and general vegetation of the plant. “In order to form a distinct conception of the quantities of alkalies in aluminous minerals,” says Dr. Liebig, “it must be remembered that felspar contains 17 $\frac{1}{2}$ per cent. of potash, albite 11.43 per cent. of soda, and mica from 3 to 5 per cent., and that zeolite contains from 13 to 16 per cent. of alkalies. The late analyses of Ch. Gmelin, Löwe, Fricke, Meyer, and Redtenbacher, have also shown, that basalt and clinkstone contain from $\frac{3}{4}$ to 3 per cent. of potash, and loam from 1 $\frac{1}{2}$ to 4 per cent. of potash. If now we calculate from these data, and from the specific weights of the different substances, how much potash must be contained in a layer of soil, formed by the disintegration of 26,910 square feet of one of these rocks to the depth of 20 inches, we find that a soil of felspar contains 1,152,000 lbs., of clinkstone from 200,000 to 400,000 lbs., of basalt from 47,500 to 75,000 lbs., of clay slate from 100,000 to 200,000 lbs., and of loam from 87,000 to 300,000 lbs.”

Potash and soda have been so invariably found in all the numerous clayey soils which have been analyzed, that they may fairly be pronounced ingredients in absolutely every description of argillaceous land. Potash always exists as a distinct and separate substance in the leys of alum manufactories; and it is formed from the ashes of the stone and brown coal, which contain much argillaceous earth. The mixture of the clayey matter properly called loam with the quartz of the new red sandstone formation, or with the lime in the different limestone formations, in so very trivial a proportion as one part to a thousand, affords as much potash to a soil only twenty inches deep as will supply a growing forest of pines with a sufficient quantity of alkali for a century; and a single cubic foot of felspar, a mineral which contains a large proportion of alumina, will afford as much as an oak wood, growing upon a surface of 26,910 square feet, will require during five years.

The land around Vesuvius in the vicinity of Naples, is one of the most fertile soils in the world; it possesses, in its different districts, a greater or less degree of fertility according to its proportion of clay or sand; and as it entirely consists of disintegrated lava, it owes its fertility, not to the product of any vegetable decomposition, but solely to the presence of mineral alkalies. When lava or volcanic ashes have been exposed for some time to the simple influence of air and moisture, they produce the most luxuriant crops of any sorts of plants which their occupants please to cultivate; and they obviously acquire all their power from the reduction of their alkalies, their alkaline oxides, and their silica into such a condition as to be absorbable by the spongioles of the plants. The multitudes of soils which, in all parts of the world, have been formed by the disintegration of rocks, either through mere atmospheric influence upon the spot, or through the action of water in transmission to a distance, are generally rich in alkaline oxides, and yield them up to the purposes of vegetation only in a slow and gradual process co-ordinately with their own increasing pulverization. Thousands of years have been necessary for the disintegration of rocks into the condition of arable lands; and, in many instances, thousands of years more will be necessary to effect such a fine comminution of these lands as to expose their minutest particles to the dissolving power of air and moisture, and to exhaust them of their alkalies. Yet not only do virgin or uncultivated soils part slowly with their alkalies under the wasting power of weather, but they continually regain a compensating quantity of alkaline matter, and even add to its amount, by alkaline deposits from their own vegetation, from the saline vapours of the sea, and from the ammoniacal gases concentrated and brought down by rain. "We see from the composition of the water in rivers, streamlets, and springs," says Dr. Liebig, "how little

alkali the rain water is able to extract from a soil even after a term of years; this water is generally soft, and the common salt which even the softest invariably contains, proves that the alkaline salts, which are carried to the sea by rivers and streams, are returned again to the land by wind and by rain. Let us suppose that a soil has been formed by the action of the weather on the component parts of granite, grauwacke, mountain limestone, or porphyry, and that the vegetation upon it has remained the same for thousands of years; now this soil would become a magazine of alkalies in a condition favourable for their assimilation by the roots of plants. The interesting experiments of Streeve have proved that water impregnated with carbonic acid decomposes rocks containing alkalies, and then dissolves a part of the alkaline carbonates. It is evident that plants also, by producing carbonic acid during their decay, and by means of the acids which exude from their roots in the living state, contribute no less powerfully to destroy the coherence of rocks. Next to the action of air, water, and change of temperature, plants themselves are the most powerful agents in effecting the disintegration of rocks. Air, water, and change of temperature prepare the different species of rocks for yielding to plants their alkalies. A soil exposed for centuries to all the influences which affect the disintegration of rocks, but from which the alkalies have not been removed, will be able to afford, during many years, the means of nourishment to [cultivated] vegetables requiring alkalies for their growth."

But the processes of cultivation entirely alter the alkaline conditions of virgin soils, rapidly drawing off their native alkalies to exhaustion, and rendering requisite either a frequent artificial supply of fresh alkalies in the form of manures, or the periodical abandonment of the land to a slow reacquirement of alkalies from saline vapours, rain water, and the chemical decompositions of spontaneous vegetations. When any virgin soil, no matter how rich in native alkalies, is subjected to unmanured cropping, and worked onward to exhaustion, it may experience a series of recruitings merely by such periodical and prolonged exposures of it to the weather as will effect the further comminution of its parts, and lay open its more minute or ultimate alkaline constituents to solution; but, if continued to be worked without any other appliance, it will eventually lose all its intrinsic alkalinity, or become intrinsically barren, and will be capable of reacquiring fertility only by the attainment of fresh alkalies from manures or from the atmosphere. The first colonists of Virginia found a virgin soil remarkably rich in native alkalies; and they drew from it annual harvests of wheat and tobacco, without the aid of manure, for a century; but now their successors are obliged to treat whole districts of it as mere poor pasture-land, or occasionally to work portions of them

into a condition of tillage, at the cost of a large supply of manure. No less a quantity of alkalies than 12,000 lbs., in leaves, grain, and straw, was removed from every acre of this land during the first hundred years of its cultivation; and the land became infertile, solely because it was deprived of almost every particle of alkali which was capable of being absorbed by the spongioles of plants, and because the fresh portion of alkali obtained, in the course of one or two years, by further comminution, by the decomposition of spontaneous vegetation, and by deposits from the atmosphere and from rain water, was not sufficient for the requisite support of another crop. Almost all the cultivated land in Europe—at least of such as has been for a considerable time in cultivation—is in a similar condition to this land of Virginia, and has so totally lost its native alkalies as to require continual fresh supplies of alkalies, through the processes of fallowing and manuring, in order to its retaining fertility.

Wheat, whose habits appear so fastidious and capricious to an unpractised or unreflecting observer, requires certain phosphates for the formation of its grain [see PHOSPHATES and WHEAT], and a comparatively large proportion of silicate of potash for the strength and growth of its culm. Hence, when sown upon sandy or calcareous soils, which have not a considerable intermixture of clay, and in consequence cannot afford a requisite aliment of silicate of potash, the young plants will be dwarfed and arrested; and when sown on a soil of decayed wood in Great Britain, or even on any of the rich humous soils of Brazil, the plants, though almost immersed in the seemingly nutritious products of vegetable decomposition, will so pine for the want of mere silicate of potash as to be feeble and dwarfish, and speedily to droop and fall.—All the grasses and all other plants of similar structure and habits require some proportion of silicate of potash, and therefore thrive by irrigation, which both conveys this substance to meadows and reduces it to solution in the soil. The numerous plants of the equisetum or horsetail type, and also the various kinds of reeds and canes, all of which require a large proportion of silicate of potash, grow luxuriantly in marshes, in ditches, in streamlets, and in such argillaceous soils as abound in potash, simply because they obtain, in these situations, easy and large supplies of their favourite alkaline aliment. Most deciduous trees, particularly such as carry a large-leaved and very profuse foliage, require for their leaves from six to ten times more alkali than pines or firs; and hence they either do not grow at all, or are very dwarfish, on many sandy or calcareous lands which are highly favourable to the growth of pines or firs,—hence also the finest forests of oaks, such as could not be produced on sandy or calcareous lands, are found on soils of gneiss, granite, and mica-slate in Bavaria, of clinkstone on the Rhone, of basalt in the Vogelsberge, and of clay-slate on the Rhine and in the

Eifel. “Can we, then, regard it as remarkable,” asks Dr. Liebig, “that oak copse should thrive in America, on those spots on which forests of pines which have grown and collected alkalies for centuries, have been burnt, and to which the alkalies are thus at once restored; or that the *Spartium scoparium*, *Erysimum latifolium*, *Blitum capitatum*, *Senecio viscosus*, plants remarkable for the quantity of alkalies contained in their ashes, should grow with the greatest luxuriance on the localities of conflagrations?” An obvious and important inference, in regard to the cultivation of wheat, of strong culmy grasses, of deciduous shrubs and trees, and of any other plants which require large supplies of alkaline matter, is that, when the land intended for them has been deprived by cultivation of its native soluble alkalies, it must be specially prepared, or brought into a condition of fitness, by one or more of the appliances for impregnating it with fresh alkalies, either the abandonment of it to a state of nature, or the growth upon it of crops which do not require alkalies, or the enriching of it with such manures as contain a large proportion of alkaline ingredients.

One of the prime offices performed by water in connexion with vegetation, is the reduction of the alkalies to such a state of solution as to render them absorbable by the spongioles of plants. During spring and the early part of summer, while soils are in a moist condition, a greater quantity of alkaline bases and salts enters the organism of land-plants, than during the middle and later parts of summer, when soils are comparatively dry or arid. The descent of rain upon a soil is the introduction of certain necessary alkaline matter in a state of readiness for use by both soil and plant, and the action of water within the soil is the preparation of other necessary alkaline matter in combination with accompanying aliments for the vegetable organism. The necessity of rain for these purposes is so specially great at certain stages of the growth of plants, that, in many districts, the stuntedness or the luxuriance, the strength or the weakness, the opulence or the poverty, of a whole season's crop of corn may depend on the presence or absence, the copiousness or the paucity, of one day's rain, or even of a single shower. In dry seasons, the lower leaves of annual plants in summer, the lower leaves of herbaceous perennial plants at a later period in summer or early in autumn, and the lower leaves of deciduous perennial short-rooted plants just before autumnal maturity, lose their vitality, become yellow, shrink, and fall. These leaves were the earliest developed; they received alkaline juices from the ascending sap of the plant, and carbonic acid and ammonia from the surface action of the atmosphere; they elaborated these ingredients into the constituents of new leaves, buds, and twigs; and, when a continuance of drought occasions a scantiness or a cessation in the supply of alkaline matter through

the ascending sap, they part with nearly all their own alkaline juices for continued elaboration with the ammoniacal and carbonic acid gases, till they cease to have a sufficient quantity for the maintenance of their own health and verdure; and they, in consequence, sicken, fade, and die. Hence, the withered leaves are found to contain mere traces of soluble alkaline salts, while the buds and sprouts are remarkably rich in these substances. "The reverse of this phenomenon is seen in the case of many kitchen-plants, when they are supplied with rich manure containing an excess of mineral ingredients; salts are separated from the surface of their leaves, and cover them with a thin white crust. In consequence of these exudations, the plant becomes sickly, the organic activity of the leaves diminishes, the growth of the plant is destroyed, and if this condition lasts, the plant finally dies. These observations are best made on plants with leaves of large dimensions, through which large quantities of water are evaporated. This disease generally attacks turnips, gourds, and pease, when the soil is drenched with sudden and violent rain, after continued dry weather, at a time when the plants are near, but have not attained, maturity; it is also necessary for its occurrence, that dry weather should again happen after the rain. By the rapid evaporation of the water, absorbed by the roots, a larger quantity of salts enters the plants than they are able to use. These salts effloresce on the surface of the leaves, and when they are juicy, act as if the plants had been treated with solutions of salts, in greater quantity than their organism could bear. Of two plants of the same kind, the one nearest maturity is most liable to this disease; if the other plant has either been planted at a later period, or if its development has been restrained, the causes which exercised injurious effects upon the first plant accelerate the development of the latter. The germ springing out of the earth, the leaf on coming out of the bud, the young stem, and the green sprouts, contain a much larger quantity of salts with alkaline bases, and give ashes on incineration much richer in alkaline ingredients, than parts of the matured plant. The leaves, being the part in which the absorption and decomposition of carbonic acid is effected, are much richer in mineral ingredients than other parts of the plant. The simple fact that a plant is restrained in growth by the want of rain to convey to it alkalies, proves completely that these alkalies play a most important part in vegetation."

The formation of sugar, starch, and other non-azotised constituents of plants is effected by means of soluble alkaline salts, or of vegetable acids in chemical combination with alkalies; it does not take place in such fruits and seeds as contain vegetable acids in a free state, or uncombined with alkalies, as in the lemon and the chick-pea, which contain respectively citric acid and oxalic acid in a free or uncombined condition; and it

takes place on the largest scale, and accumulates the greatest stores of sugar, starch, and similar substances, in those plants which are richest in soluble alkaline salts, or in the bases and the acids of which these are formed. A deficiency in sugar, starch, and woody fibre, in the plant, is the necessary consequence of a deficient supply of alkaline matter in the soil; and a luxuriant produce in these, or a large amount of the vegetable elements of nutrition for animals, is a general consequence of an abundant supply of alkalies. Hence an excellent crop, as to either the vigour of its growth, the soundness of its organism, or the large amount of its food for the use of man, can be obtained only when the soil possesses alkaline bases in sufficient quantity for the plant's use, and in a condition suitable for absorption. "The compounds containing nitrogen and sulphur, as well as the alkalies and phosphates," remarks Dr. Liebig, "are constituents of the blood of animals; but the conversion of the former into blood cannot be conceived without the presence and co-operation of the latter. According to this view, the power of any part of a plant to support the life of an animal, and to increase its blood and flesh, is in exact proportion to its amount of the organic constituents of the blood, and of the materials necessary for their conversion into blood,—viz., of alkalies, phosphates, and chlorides (common salt or chloride of potassium). It is highly worthy of observation, and of great significance to agriculture, that the vegetable compounds containing sulphur and nitrogen, which we have designated as the organic constituents of the blood, are always accompanied, in the parts of the plants where they occur, with alkalies and with phosphates." The tubers of the potato and the roots of the beet contain vegetable albumen, alkaline salts, and soluble phosphate of magnesia; the seeds of pease, beans, lentils, oats, rye, barley, and wheat contain starch, alkaline phosphates, and earthy salts; and the parts of these plants which are poor in the properties of food for animals, are proportionally poor both in the substances which result from the combined action of alkalies and organic acids, and in those which result from the joint presence of alkalies, phosphates, nitrogen, and sulphur. As regards, therefore, either the azotised or the non-azotised adaptations of cultivated vegetables for the uses of man and the domestic animals, one invariable and most important condition of every good crop is the presence in the soil of an ample supply of soluble alkaline matter. But this great topic, under certain modifications, will again and again meet us in a number of our future articles, and hence must not be regarded as at present fully discussed. See, in particular, the articles AMMONIA, POTASH, SODA, SALTS, MANURE, NITRATES, SULPHATES, GYPSUM, LIME, PHOSPHATES, ALKALOIDS, ALKALINE BASES, and ALKALINE SALTS.

Alkalies and alkaline earths, when mixed with various substances which do not absorb oxygen,

such as alcohol, tannin, gallic acid, the vegetable colouring matters, and several other substances, give them an affinity or capacity for oxygen; and, for this reason, when alkaline solutions are applied to any timber, they occasion it to be saturated with oxygen, and in consequence accelerate its decay. Solutions of potash or soda, in the proportion of two or three weights of water to one weight of the alkali, or lime water diluted with its own weight of water, or strong solutions of borax, or of any alkaline carbonates, will, for many months, protect delicate instruments of iron and steel from oxidation, and preserve them in a state of complete polish.—*Dr. Dana's Prize Essay on Manures.*—*Liebig's Chemistry of Agriculture.*—*Ure's Dictionary of Chemistry.*—*Boussingault's Rural Economy.*—*Quarterly Journal of Agriculture.*—*Davy's Agricultural Chemistry.*

ALKALINE BASES. Either the alkalies and alkaline oxides entering into chemical combination with mineral acids to form salts in the open air or in the soil; or the alkaloids or vegetable alkalies entering into organic combination with vegetable acids to form salts within the organism of plants. General chemists seem usually to employ the designation alkaline bases in the former sense; and agricultural chemists seem usually to employ it in the latter sense. See **ALKALINE SALTS** and **ALKALOIDS**.

ALKALINE EARTHS. The results of the union of oxygen and the metallic bases barium, strontium, calcium, and magnesium, all of which, with the exception of the last, decompose water rapidly at common temperatures. The term alkaline earths is derived from the properties possessed by them in common with the alkalies proper, while in other respects they resemble the earths. Baryta, strontia, and lime are strongly caustic, magnesia less so. The two former are rather soluble in water, lime less so, and magnesia requires a very large quantity of water for solution. See **ALKALIES**, **BARYTES**, **LIME**, **MAGNESIA**, and **STRONTIAN**.

ALKALINE OXIDES. See **ALKALIES**.

ALKALINE SALTS. Substances formed by the chemical combination of alkalies and alkaline earths with acids and oxides. All the alkaline substances which exert their alkalinity exteriorly to vegetable organism, have a great affinity for acids, and readily combine with them to form alkaline salts. The compounds thus formed are of a neutral character, or want the characteristic properties of both the alkalies and the acids out of which they are formed; and they are designated alkaline salts in order to be distinguished from metallic salts, which are formed by the combination of metals with acids. The most important of the alkaline salts in agricultural chemistry—whether as regards natural action or manuring—are the carbonates of lime, potash, soda, magnesia, and ammonia, the silicates of potash, soda, lime, magnesia, and alumina, the phosphates of lime, magnesia, potash, soda, and

alumina, the sulphates of potash, soda, lime, magnesia, alumina, and ammonia, the nitrates of potash, soda, lime, magnesia, and ammonia, the oxalates of lime and potash, the muriates of lime and ammonia, and the tartrates of lime and potash, formed by the combination of carbonic, silicic, phosphoric, sulphuric, nitric, oxalic, muriatic, and tartaric acids, with the respective alkalies and alkaline earths. Ammonia and many of the alkaline earths also combine with the metallic oxides,—ammonia, for example, with the oxides of copper, cobalt, and nickel, and potash and soda with the oxides of lead and zinc.

The part which alkaline salts play in the chemical processes attendant upon agriculture, is quite obvious and exceedingly important. Some particular crops, in order to be productive, or even in any degree thriving, actually require the presence in the soil of a precise kind of alkali. The vine, for example, must be supplied with potash in order to elaborate the large quantity of bitartrate of potash which characterizes the grape; the sorrel must be supplied with the same alkali, in order to elaborate its copious and characteristic organic solution of binoxalate of potash; and the numerous plants of the fuci and chenopodiæ families which produce kelp and barilla, must be supplied with some salts of soda, in order to their assimilating the pure alkaline soda which they yield up by incineration. "It would appear, however," says M. Boussingault, "that the salts of soda or potash must not exceed a very small proportion in the soil. All the experiments that have yet been undertaken with a view to ascertain the action of different saline substances on growing vegetables, have led to no very certain conclusion but this, that they must be used very sparingly. M. Lecoy has published an account of some experiments, made apparently with great care, which go to prove that common salt, in the dose of from $1\frac{1}{2}$ to $2\frac{1}{2}$ cwts. per acre, favoured the growth of barley, wheat, lucern, and flax. Chloride of calcium and sulphate of soda, he also found to have the same good effects. M. de Dombasle, however, came to conclusions totally opposed to them, with reference especially to common salt, which, applied in the doses advised by M. Lecoy, was not found to produce any sensible effect. M. Pavis also obtained results that were equally negative." See articles **SALTS**, **POTASH**, **SODA**, **LIME**, **MANURES**, &c.

ALKALINITY. See **ALKALIES**.

ALKALOIDS, or VEGETO-ALKALIES. Unique alkaline substances produced in plants during the progress of vegetation. The first of them known to science, or detected as a distinct substance, was morphine, a constituent of opium; and this was discovered by Sertuerner in 1804. So very many are now known, that we cannot afford them separate notice, or even enumeration; but some of them are exceedingly obscure, most are of very small importance, and all have the same kind of relation to individual genera or species of plants

as the greater number of the vegetable acids. The alkaloids have the same general properties as the alkalies; they bear a considerable resemblance to one another in both constitution and chemical action; they consist of various, though in each instance, definite proportions of carbon, hydrogen, oxygen, and nitrogen; they have a chemical behaviour similar to that of ammonia; they combine with the hydrates of the oxacids, and, when deprived of their water of crystallization, they fix the hydracids without losing weight; they are, for the most part, either but slightly soluble, or not soluble at all, in water; yet all are soluble in alcohol; and some of them are sufficiently volatile to be capable of distillation. Among the most remarkable are morphia and narcotine, found in opium; quina and cinchonia, in Peruvian bark; atropia, in deadly nightshade; digitalia, in foxglove; hyoscyamia, in henbane; picrotoxia, in *Cocculus Indicus*; solania, in woody nightshade; strychnia, in *Nux vomica*; and veratria, in white hellebore. The curious reader will find full notices of these, and of many more, in Thomson's Vegetable Chemistry. The alkaloids have been very extensively adopted into medical practice, and already make a prominent figure, and play a powerful part, as drugs.

ALKANET, or Bugloss,—botanically *Anchusa*. A genus of herbaceous plants of the Borage tribe. The number of species is twelve; and of these, the common and the evergreen are natives of Great Britain, the paniced is from Madeira, the Cape from the Cape of Good Hope, the pale-flowered from the Caucasus, the Italian, the narrow-leaved and Barrelier's, from the south of Europe, the rock from Siberia, the wave-leaved from Spain, the dyer's from the south of France, and the pink from the Levant. The evergreen, the common, the Cape, and the narrow-leaved, are evergreen; and all the others are deciduous. The paniced, the Cape, and the Italian, are biennials; and all the others are perennials. The Cape is a greenhouse plant, and all the others are hardy. All the species are ornamental plants. The dyer's—*Anchusa tinctoria*—is used by British druggists for colouring drugs, by British vintners for colouring and flavouring adulterated wines, and by the inhabitants of the south of France for colouring alcohol, wax, oils, and unguents. The common—*Anchusa officinalis*—grows wild in Kent and Cornwall, but is cultivated as a garden plant in other counties. It flowers from June till autumn; and its roots, in their dormant or ripe state, are red and astringent. As analyzed by John, it gave 5.5 colouring matter, 6.5 gum, 1.0 soluble extractive matter, 65.0 extractive deposit soluble in potassa. This plant has a close resemblance, in its properties, to borage; and it abounds in honey, and is very attractive to bees. The herbalists say that an ointment made from its roots is good for bruises; that a decoction of the whole plant, mixed with honey, and taken in large doses, cures jaundice, ague, and diseases of the

kidneys; that a hot decoction of it in beer is good for measles and small-pox; that its leaves, applied with honey and meal, heal luxations; that the leaves and the root in wine correct disorders of the womb; and that an infusion of the leaves and of hyssop kills intestinal worms. The colouring matter is after all the only important principle in this plant.

ALLANTOIC FLUID. The space between the allantois and amnion of most mammalia contains the urine of the fetus, called the allantoic fluid. The allantoic fluid of the cow contains allantoin, albumen, lactate of alkali, ammonia, phosphates, and common salt. Alcohol extracts allantoin and a yellowish brown substance; the former is obtained by evaporation and crystallization. It has not been examined for urea.

ALLEY. The vacant space between two parallel beds of corn; also a straight walk in gardens or pleasure-grounds, and between two rows or ranges of shrubs or trees.

ALL-HALLOWS, or ALL-SAINTS. An ecclesiastical festival in honour of the whole hierarchy of Romish saints; and, by a metonymy, the first day of November, that being the day on which the festival is held. All-Hallows is the old English form of the name; and is still extensively, though not classically, in use. High mass having been appointed in the church of Rome as a chief feature in the observance of the festival, the name all-hallows took the form of all-hallowmas, in exactly the same manner as the festivals in honour of the Lord Jesus Christ and of the archangel Michael, took the names of Christmas and Michaelmas; and this designation, all-hallowmas—sometimes in the abbreviated form of hallowmas—is still retained in the popular phraseology of the northern counties of England. The original festival decidedly appears to have been heathen; and it was transferred to the church of Rome on occasion of the Roman Pantheon, or temple of all the pagan deities at Rome, being set apart to the purposes of Roman Catholic worship, and dedicated to the whole hierarchy of Roman Catholic saints. The eve of the festival, or the 31st day of October, usually called All-Halloweven, or abbreviatedly Hallowe'en, has long been regarded by the rural population of Great Britain as one of the greatest epochs of the year, and observed with many rejoicings as a sort of general harvest home, and with not a few curious, superstitious, heathenish, and most censurable rites as a season for prying into futurity. Some of the observances in England amount to little more than cheerful merry-making; but most of those in Scotland are an outrage upon common sense, upon good morals, and upon the Christian religion.

ALL-HEAL, or GINSENG,—botanically *Panax*. A genus of plants of the Angelica-tree tribe. The number of species is probably about sixteen; but only four seem to have been introduced to Bri-

tain. Two of the species cultivated with us—*aculeatum* and *fruticosum*—are hothouse plants of little consequence; and the other two—*quinquefolium* and *trifolium*—are well known, widely diffused, interesting, hardy perennials, natives of North America and of Chinese Tartary. The name *Panax* is faithfully translated by *All-heal*, and claims for the genus the properties of the 'universal elixir,' or a remedy for every disease; and though utterly absurd in Britain, where none of the species are found to possess any noticeable medicinal virtue, it quite appropriately represents the opinion entertained of the species *quinquefolium* by the Tartars and Chinese. "In Chinese Tartary, this species has been gathered as an invaluable drug from time immemorial. The roots, which are said to bear some resemblance to the human form, are gathered and dried, and enter into almost every medicine used by the Tartars and Chinese. Osbeck says that he never looked into the apothecaries' shops but they were always selling ginseng, that both poor people and those of the highest rank made use of it, and that they boil half an ounce in their tea or soup every morning, as a remedy for consumption and other diseases. Jartoux relates that the most eminent physicians of China have written volumes on the medicinal powers of this plant, asserting that it gives immediate relief in extreme fatigue either of body or mind, that it dissolves petuitous humours, and renders respiration easy, strengthens the stomach, promotes appetite, stops vomiting, removes hysterical, hypochondriacal, and all nervous affections, giving a vigorous tone of body even in extreme old age."—[*London's Encyclopædia of Plants*.] The Canadian French also use the root of this plant as a cure for asthma and for stomach complaints. Jartoux, as quoted by Miller, says that he tried the plant with good effect upon himself, and that, in the year 1709, the emperor of China employed ten thousand Tartars to gather it in the deserts. Both the *Panax quinquefolium* and the *Panax trifolium* thrive well in the open ground of English gardens, in a light rich soil.—The Druids gave the name of all-heal to the mistletoe, *Viscum album*.

ALL-HEAL (CLOWN'S), or IRONWORT,—botanically *Sideritis*. A genus of plants of the labiate tribe. Most of the species known in Great Britain are natives of the south of Europe, and particularly of the districts on the sea-board of the Mediterranean; three or four species are cultivated for rare economical purposes, and twelve or thirteen species as ornamental plants; three, the Roman, the mountain, and the dark-flowered, are annuals,—seven, the perfoliate, the holly-leaved, the hyssop-leaved, the scollop-leaved, the spiny, the hairy, and the fetid, are hardy perennials,—seven are plants of the frame or the greenhouse,—and the remaining species, amounting to about twenty-five, have not been introduced to Great Britain. The species best known to the ancient Greeks had the same, amongst that

people, of being able to heal all wounds made by the sword; but they are not known by the moderns to possess any such virtue.

ALLIUM. A very extensive genus of edible, acrid, strongly-scented plants of the Asphodel tribe. Some are of great antiquity as potherbs; and all have the odour of their types, onion and garlic. The number of species is upwards of 100; and the number of varieties of some of the species is considerable. The leek, *Allium porrum*, and the common onion, *Allium cepa*, are biennials; but all the other species are perennials. The Welsh onion, *Allium fistulosum*, is an evergreen herbaceous plant; but all the other species are bulbous. Nearly all are natives of the northern hemisphere; and most are found wild in the meadows and groves of Europe, Northern Asia, and Northern Africa, only a small proportion occurring within the corresponding latitudes of North America. Many are handsome flowering plants; but the best known, particularly onions, leeks, garlic, chives, shallot, and rocambole, are cultivated in the kitchen-garden. See articles ONION, LEEK, GARLIC, CHIVES, SHALLOT, &c.

ALLODIUM. Landed property held in absolute possession, without any relative tenure, or any obligation of rent, service, or fealty to a superior. In law, allodial is used in contradistinction to *feudal*, in which sense all moveable property is allodial. *Feodum* or fief was property held under distinct acknowledgment of inferiority and stringent obligations of service, and formed the basis of the relation between vassal and lord; and allodium was the converse of *feodum*, acknowledging no inferiority, and lying under no obligation. The lands of the Franks, who succeeded the Romans in the possession of Gaul, were called allodial; they were subject to no impost, except that of military duty, sanctioned by liability to fines; and they passed in equal partitions to all children, or, in default of children, to all relations within certain limits of consanguinity. The allodial tenure prevailed in most of France from the end of the fifth to the end of the eighth century; it prevailed in other continental districts of the quondam Roman empire so long as Roman law continued to be in force; it prevailed in England till about the period of the Norman conquest; and it prevailed in the Orkney and the Shetland islands to so late a period as to present there till the present day some of its monuments and usages. The name allodium is sometimes, though improperly, employed to designate an estate which has been inherited from ancestors, in order to distinguish it from an estate obtained by gift or purchase.

ALLOTMENT SYSTEM. The letting of small plots of ground to cottagers, for cultivation during leisure time with the spade, and as a means of increasing their families' maintenance and bettering their condition. The plots vary in size from less than a rood to several acres, but probably do not average more than one-third of an

acre; and they are let under such conditions as oblige the occupants, not to prosecute labour on them as their chief or permanent employment, but to use them only as a supplementary or an occasional resource. They differ widely, in both principle and tendency, from the small farms of Ireland; they are subjected, not to general or mixed husbandry, but only to the raising of cereal and culinary crops by spade tillage; and they both furnish employment to farm cottiers who are out of situations, and serve as resources to the various descriptions of farm labourers who have industrious habits, or who can command assistance in labour from some members of their families, or who were formerly small farmers, and lost possession of their holdings in consequence of the consolidation of farms. The tendency of the allotment system, when judiciously planned and managed, is to encourage and develop industry, to initiate the young members of cottiers' families to early habits of active husbandry, to raise the tone of morals and economy among all classes of the rural peasantry, and to substitute productive labour for pauperism, sturdy independence for effeminate sycophancy, comfort for penury, and general social well-being for a starving, discontented, relaxed, and dislocated condition of society.

A system, similar to the modern allotment system, was suggested to the legislature in the reign of Queen Elizabeth; but it seems not to have been fairly appreciated, and was reduced to very limited operation. Another similar system was partially adopted, in the year 1707, in the duchy of Cleves; but this also appears to have been of no great extent. A similar system was commenced in 1818, by the establishment of institutions called free colonies, in various parts of Holland and Belgium; and this, unlike the preceding, has been eminently useful in the case of the former country, though not equally so in the case of Belgium. The free colonies—so called because their inmates were voluntary—were established by national subscription, aided by the government. They were commenced in Holland by the purchase of 1,300 acres of tolerably good land, and 2,600 acres of heath-district, at Frederick's Oord or district, near Steenwyk, on the confines of the Drenthe, Overijssel, and Friesland. This land was divided into plots of seven acres each; and placed under the control of commissioners, who should superintend the industry and inspect the moral conduct of the tenants. The colonies are of various grades, or under various regulations, adapted to four different classes of occupants; one grade being designed for the least reduced and best behaved kind of paupers, a second grade for the lower and culpable kinds of paupers, a third grade for orphans, and a fourth grade for general misdemeanants or for persons expelled from the former grades in consequence of bad conduct. The colonists are employed partly in manufactures, but chiefly in husbandry; they

labour solely with the hand, unaided by machinery; and they amounted, several years ago, to about 10,000. The original expense of establishing each individual was £22 6s. 4d.; an advance of capital, when requisite, was made in form of a loan; and an obligation was imposed to pay rent to the amount of twelve shillings per acre. Many of the free settlers or better sort of paupers, have already repaid the sums advanced to them; and some of even the poorest sorts of tenants are growing into prosperity; yet the colonies still require to be maintained by public subscription. A gentleman who visited the colony of Frederick's Oord a number of years ago, said, "The crops were luxuriant, the colonists healthful, and the houses comfortable. Several of the colonists had acquired considerable property. Many gardens were planted with currant bushes, pear and apple trees, and tastefully ornamented with flowers. Additional live stock, belonging to the colonists themselves, was frequently pastured out; and around not a few of the houses lay webs of linen bleaching, which had been wove on their own account by persons who, only four years before, were among the outcasts of society. The families found at dinner had quite the appearance of wealthy peasants; and from the quantity and quality of food before them, they might have been considered as not inferior to the smaller tenantry of this country." The settlements in Belgium are—as we have hinted—far behind the colony of Frederick's Oord in prosperity. One of the greatest errors committed by their founders appears to have been the establishing of the infant colonies upon a soil so sterile as to require tenfold labour and expense in tillage and manure.

About the year 1800, Dr. Law, Bishop of Bath and Wells, set the first example of instituting the modern allotment system in Great Britain. About the same time, Sir H. Vavasour communicated to the Board of Agriculture a statement of some experiments which had been made to test the Flemish system of free colonies, and which had proved that system to be highly advantageous. In 1802, Charles Howard, Esq., set another example of instituting allotments. In following years, up to the present day, the patrons and promoters of the allotment system have been very numerous; in not a few instances, they have been both distinguished for their rank and eminent for their zeal; and among the most prominent may be named Captain Scobell of High Littleton in the vicinity of Bath, Sir Henry E. Bunbury of Boston, Lords Winchelsea, Beverley, Carrington, and Brownlow, Sir Thomas Bernard, Sir John Swinburne, Mr. Burdon of Castle-Eden, Mr. Babington of Leicestershire, Mr. Gilbert of Eastbourn, the rector of Springfield in Essex, and a considerable number of the Established clergy. In 1831, the Labourers' Friend society—whose direct object is to promote the allotment system, and whose course of effort has hitherto been eminently successful—was formed in London; and

this great and most useful association was patronized by William IV. and Queen Adelaide, and also enjoys the patronage of her present majesty. Since 1831, various societies for counties, districts, and parishes, have been formed, either on the model or after the example of the Labourers' Friend society; and so far as England is concerned, they have in general been successful and beneficial. Within a recent period, likewise, parish-officers have had legal authority to rent or purchase land, not exceeding twenty acres for each parish, and to lay it out in allotments for the labourers of the parish.

Considerable diversity exists in the principles, details, and management of the very numerous series of allotments which have been instituted throughout England; yet all may be summarily viewed as rejecting the Flemish plan of home colonies for giving entire employment and support to settlers, and as embracing only the plan of family allotments for giving occasional or supplemental employment during leisure hours or at particular seasons. A plan somewhat similar to that of the home-colonies, indeed, has been established and prosecuted on the reclamative crown-lands of Ireland, and on the estates of the Irish Waste Land society; yet it really has a much closer resemblance to the small farm system which prevails throughout Ireland than to the home colony system; and in so far as it resembles the latter, it is altogether inapplicable to the circumstances of almost any district in England. Home colonies on waste lands have been recommended as a means of support for the redundant labouring population; but, however suitable they may, in common with emigration, be regarded for that purpose, they cannot, by any possibility, have either an enduring or an efficient tendency to elevate the rural population's tone of character, or improve their physical, domestic, and social condition. The plan of family allotments, when duly guarded against abuse, and fully accompanied with provisions for maintaining good husbandry and sound morals, has been found fully and rapidly to achieve all the benefits proposed by the allotment system.

The Labourers' Friend society—who have experimented the plan on the largest scale, and have a pre-eminent title to be regarded as exhibiting a model for general imitation—give the following formal statement of their principles: "First, The Labourers' Friend society does not recommend the investment of capital in land, either in shares or any other form, except so far as it may be deemed expedient, by parishes or local associations, to rent a suitable quantity to carry their plans into effect. Second, Home-colonization, or the settling a pauper population in any part of the country for the cultivation of waste or other lands, is not the plan recommended by the society. Third, The society recommends the letting to the labourer so much land only as he can cultivate with the aid of his family during his

leisure time; consequently, not sufficient to make him a small farmer, or in any way independent of his regular labour. The question of the preferableness of small or large farms comes not within the society's province. Fourth, The land allotment system does not tend to the promotion of a cottier population similar to that which exists in Ireland, the quantity of land being limited to that which the labourer can cultivate during his leisure hours, and the rent not exorbitant, but the sum paid by the neighbouring farmers. Fifth, In recommending spade-husbandry, the society confines its remarks to the effects of voluntary labour, on the small portions of land proposed as an allotment, without reference to the question of profit and loss on a large scale, or of its applicability to agriculture in general. Sixth, The society does not encourage the removal of labourers from one parish to another, but proposes rather to benefit them wherever they are found, to attach them to the soil, and to equalize the supply of labour to the demand. Seventh, The system recommended by the society is founded on the basis of profit to the labourer, not charity or almsgiving. It assumes that there is a surplus of labour, and that, in some parts of the country, the labouring man cannot obtain such full and constant employment as is adequate to his subsistence; it proposes, by allotting to him a small quantity of land, to find him profitable occupation for that part of his time which his employer does not require; and thus, by furnishing him with the means of raising a proportion of his most wholesome food in the most economical manner, he is made, by his own exertions, independent both of the parish and the charity of his neighbour."

The following rules, adopted in the parish of Woburn, are submitted by the society to the consideration of other country-associations: "First, The rent to be paid yearly, on the 11th of October. Second, No occupier will be suffered to relet his allotment. Third, No person shall be employed on the land who does not belong to the parish. Fourth, No occupier will be allowed to plough his land, but be required to cultivate it solely by spade husbandry. Fifth, If any occupier is found neglectful in the cultivation of his land, he will not be permitted to hold it after the current year. Sixth, No occupier who is at work for the parish or for any employer will be allowed to work upon his land after six o'clock in the morning, or before six in the evening, without permission from his master. Seventh, No occupier will be suffered to trespass upon another's allotment. Eighth, All occupiers will be expected to attend regularly at divine service, to conduct themselves with sobriety at all times, and to bring up their families in a decent and orderly manner. Ninth, Any occupier who may be convicted of poaching, thieving, or of any other offence against the laws of his country, will be deprived of his garden." Other rules recommended for adoption are, that any occupier shall not plant more than half of his allotment with potatoes in any one year; that every occupier shall manure his allotment, at least once in two years, with not less than twelve cart-loads of rotten dung per acre, or a proportionate quantity of other manure; that any occupant shall be at liberty to re-

linquish his allotment, by giving six weeks' notice to the committee, who shall accept a new tenant, and cause a valuation to be put upon the crop, to be paid by the incoming tenant; that if the rent of any allotment be in arrear fourteen days after the time fixed for payment, the committee shall be at liberty to resume the occupation of such allotment, paying the occupier the value of the crops, after deducting the rent due; that the quantity of land let to any person be at the discretion of the committee, yet shall in no case exceed a quarter of an acre; and that if any occupier be a drunkard, or in the practice of frequenting public-houses or beer-shops, and shall persist in such habits after having been reprov'd, he shall not be allowed to continue to rent his allotment after the end of that year.

In 1844, or only thirteen years after the society's formation, no fewer than 100,000 families are supposed to have obtained allotments or field-gardens, through the instrumentality of the Labourers' Friend society. The advantages realized by this great body of population have been many and great; and the additions which, in consequence, have been made to the national wealth, the general improvement of society, and the advancement of knowledge and morality, are far from being inconsiderable. The mere money profit obtained per acre from the lands under allotment, has been estimated by Sir Henry E. Bunbury, who has had part of his estates in field gardens for twenty-eight years, at from £7 to £10; by Mr. Harris Weatherly of Basingstoke, who gave allotments to seventy-five families during the years 1830-32, at £10 and upwards; and by several of the most extensive and experienced promoters and observers of the system—particularly by the Bishop of Bath and Wells, who has 500 allotments on his own property, and by Captain Scobell, who testifies to upwards of one thousand allotments—at from £20 to £25. Many, perhaps most, of the occupiers themselves have readily concurred in these high estimates of their profits; and not a few have declared that, in indirect methods, and by industrial and moralizing tendencies, additional advantages have been gained, of a kind even more valuable than the direct money profits. The landlords have obtained as regular and ample returns of rents as from any other class of tenants; the farmers have found their labourers steadier, manlier, and more intelligent and active; the parish officers have found pauperism and the prevalence of dissolute habits very materially decreased; and general society have been delivered from a large amount of nuisances, petty depredations, juvenile delinquencies, and degrading immoralities. In one parish, the influence of the allotment system, combined perhaps with the influence of contemporaneous circumstances, reduced the poor rates in a few years from £2,074 2s. 8d. to £649; in another, from £206 8s. to £4 12s. 6d.; and in another, in the course of one year, from £3,200 to £2,000. "The moral effects of the system," remarks Mr. Doyle, "cannot be disputed. The honesty, sobriety, and industry, the emulation in cultivat-

ing the land, the punctuality in the payment of rent, the good feeling created between the landlord and his tenant, and the improved attention of the latter to his social and religious duties, are amongst the beneficial effects which are apparent in some hundreds of villages in different parts of England. In the publications of the Society, many interesting instances are given of an entire moral reformation of character having been effected by means of an allotment of land, of men of vagrant, dishonest, and immoral habits—some of whom had been guilty of grievous penal offences—becoming steady, industrious, and respectable members of society." Much of the distinctive character of the allotment system depends on the restriction of labour to the use of the spade. See therefore the article SPADE HUSBANDRY.

In July 1843, a Parliamentary committee appointed to inquire into the results of the allotment system, reported favourably of it, and recommended the following arrangements and regulations in conducting it:

1. As it is desirable that the profits of the allotment should be viewed by the holder of it in the light of an aid, and not of a substitute for his ordinary income accruing from wages, and that they should not become an inducement to neglect his usual paid labour, the allotment should be of no greater extent than can be cultivated during the leisure moments of the labourer and his family. The exact size which would meet this condition must of course vary according to the nature of the soil, the strength and numbers of the family, and their leisure time; but one quarter of an acre is the size usually adopted, and best suited to the average of cases.

2. The allotment should also be near the dwelling of its occupier; much of its benefit depends upon the facility afforded to the man, his wife, and his children, of devoting spare moments to the care of their ground, and being able to visit it frequently without fatigue.

3. Though the land will yield larger profits under this mode of cultivation, than under the usual method of tillage, the proprietor who wishes to benefit the poor man should not exact more rent than he could expect to receive if he let it out to be farmed in the ordinary way.

4. Tithes, parochial rates, taxes, and all other charges should be included in the rent, and paid by the owner and not by the occupier, for the purpose of saving trouble in the collection, of preventing the accumulation of arrears, and of guarding the tenant against frequent and sudden demands for payments which he might not be prepared to meet.

The rules adopted in places where the allotment system has been most successful, have insisted upon spade culture, have forbidden all underletting and working on Sunday, and have required that all causes of forfeiture, viz. non-payment of rent, gross misconduct, or wilful neglect of the land, should be embodied in the agreement signed by the tenant. The rotation of crops has sometimes been enjoined in the rules; but that is a matter which may well be left to the discretion and experience of the cultivator.

ALLOTMENTS OF LAND. The sections or proportional parts into which an enclosed common is divided. They belong to the parties who possessed right of commonage; and ought to be proportionate to the respective extent of claim,

founded on the possession of lands and tenements in the parish, townland, or other district in which the divided common is situated.

ALLOWANCE. A deduction from rent, either on account of the total or partial loss of the subject let, or for the repair of farm-buildings, the improvement of land, or any other special purpose. It is also known as *Deduction* or *Abatement*. The following summary of principles applicable to this subject is taken from Mr. Hunter's 'Treatise on the Law of Landlord and Tenant:'

1st, Where the loss is occasioned by natural or artificial causes, which the lessee could not contemplate at all, or which are contrary to probability, or which may be accidentally inherent in the subject, the lessee will be entitled to exemption or deduction. These causes may be natural, as—with relation to agricultural subjects, permanent sterility, storm or inundation—to fisheries, a change of the stream, or migration of the fish—in minerals, exhaustion, or the occurrence of impenetrable strata; or they may be artificial, as fire, the fall of a neighbouring house, a foreign enemy, or a mob.

2dly, Exemption or deduction may be claimed, although the sterility or vastation be not total; if it be what is termed *plus quam tolerabile*. No definition of this phraseology is given either in the Roman or Scotch law; but the common opinion is said to be, that the tenant will be liable for the rent, if the produce exceed the expense of production. On this topic there is much learning in the works of the civilians, but too subtle to be useful.

3dly, The cause of loss must not be such as, though natural, can be deemed to have been in the contemplation of the lessee when he contracted. The gradual deterioration of the soil, short of sterility, blight, insects, injury by rain after reaping, decay of fruit-trees, or similar causes, will not operate, although they may not only prevent profit, but exhaust capital. Increase of depth, or accumulation of water in a mine, will not give liberation or abatement to the lessee, although the addition to the expense of working should create positive loss. A lessee of fisheries will not be exempted although the adjoining proprietors, exercising their known legal rights, erect works which may injure the fishery.

4thly, Loss arising from the abandonment of a neighbouring market, or, conversely, from a greater supply, or from a supervenient law or judicial determination, does not come within the exemption. There is a series of decisions in accordance with these maxims.

ALLOXAN and ALLOXANTINE. Chemical compounds formed by the action of nitric acid on uric acid. They contain the same elements as gluten, but in different proportions; and are convertible into each other simply by the abstraction or addition of one equivalent of hydrogen,—alloxantine being in all respects the same as alloxan with the addition of one equivalent of hydrogen. Alloxan is formed from alloxantine by oxidizing substances; and alloxantine is formed from alloxan by deoxidizing substances. The mutual relation of gluten and ferment—an obscure and difficult yet considerably important question—is supposed to be exactly analogous to this very close mutual relation of alloxan and alloxantine. See articles GLUTEN and FERMENTATION.

ALL-SAINTS. See ALL-HALLOWES.

ALL-SPICE (CAROLINA)—botanically *Calycanthus*. A genus of small, deciduous, North American shrubs, the type of the natural order *Calycantheæ*. Three species are cultivated in this country, *floridus*, *fertilis*, and *lævigatus*; and two others have not been introduced. Their calyxes are odoriferous and chocolate-coloured, and have the appearance of corollæ or flowers; and hence the name of the genus *Calycanthus* or *Calyx-flower*. The most popular species *Calycanthus Floridus*, yields a fragrance like that of true all-spice or pimenta; and always bears the name of all-spice in its native country, Carolina. It seldom, in Great Britain, attains a height of more than five feet. Its branches deflect from the stem near the ground; they are numerous, irregular, and of a brown colour; and when bruised, they emit an agreeable aromatic odour. Its leaves are nearly four inches long and two and a half inches broad; they have a pointed oval outline; and they stand in pairs, opposite one another, along the branches. The flowers stand single on short footstalks, and bloom in May and June. Young plants of Carolina all-spice are easily though slowly obtained by layering; and they require to be nursed with care till they acquire some strength and hardiness.

ALL-SPICE-TREE—botanically *Pimenta*. A handsome, evergreen tree, of the myrtle tribe. It is a native of the West Indies, abounds in the hilly parts of the north side of Jamaica, and produces the well-known pepper-berry, popularly called all-spice or Jamaica pepper. It is a stove plant in Great Britain; but grows indigenously to the height of thirty feet in the West Indies. Its berries are spherical and purple; they are gathered before being ripe, and carefully dried on mats, or terraced-floors, or in kilns; and they bear the name of all-spice in consequence of their aroma having some resemblance to that of a good mixture of all other sorts of spices. Only one species is known,—*Pimenta vulgaris*; and this was treated by the older botanists as a myrtle, and called *Myrtus pimenta*.

ALLUVIUM. Aqueous deposits of gravel, sand, earth, silt, marl, and the miscellaneous matters which result from the disintegration of rocks and the comminution of diluvium, detritus, and organic remains. Alluvium, though a term of strictly scientific use, and of very frequent occurrence in works upon geology and physical geography, is employed by different writers in very different senses, and sometimes has great looseness and variety of meaning in even a single treatise. Some writers employ it to denote all aqueous deposits of every age and character, and so make it include all the sedimentary or stratified rocks; others employ it to denote all aqueous deposits which retain their original constitution, or have not been modified or altered by igneous action, and so make it include all the great divisions of rocks usually called tertiary and secondary, and some of those usually called

transition; others employ it to denote all aqueous deposits of sufficiently recent formation to contain fossils of only the existing species of animals and vegetables, and so make it include several series of the newer geognostic formations; others employ it to denote all loose earthy strata, whether soil or subsoil, superimposed on indurated rock, and so make it include diluvium and every kind of detritus and mineral debris; others employ it to denote all aqueous deposits of a merely mineral kind, or deposits altogether or nearly free from animal and vegetable remains, and so make it exclude the vast aggregate extent of the most recently formed strata which abound in shells, shrubs, grasses, and other organic remains; and others employ it to denote all aqueous deposits of a merely mineral kind constituting dry land, and so make it exclude the vast aggregate extent of quite new formations in lakes, estuaries, bays, and gulfs, and along the margin of seas and oceans. The two last of these senses appear to us too contracted, and all the others too extended. The most ancient aqueous deposits, altered by the action of fire, are properly metamorphic rocks; the next most ancient aqueous deposits, slightly if at all affected by the subsequent agency of fire, are transition or silurian rocks; the next great series of aqueous deposits, including very numerous members, and ranging from the old red sandstone upward to the summit of the chalk formations, are secondary rocks; the next series of aqueous deposits, consisting principally of the sands and clays nearest to the chalk formations, and of hard white sandstones and the newest limestones, are tertiary rocks; the loose aqueous deposits made by vast floods, particularly by the general deluge, and spread out in great expanses over hill and dale, and constituting a deep subsoil in regions and districts where hard rocks cannot easily be found, are diluvium; and the loose deposits, effected by the attrition of the weather upon hard rocks, and constituting thin soils on the sides of rocky mountains and in other situations where the hard rocks of which they were formed occur near the surface, are detritus when lying on the very spots where they were disintegrated, and debris when washed only to such a distance as to retain their mineral character unchanged. Now when all these various deposits have separate, distinguishing, and explicit names, they cannot be made to share the additional designation of alluvium without the utmost violence to logic and the greatest confusion to nomenclature. On the other hand, to exclude from the name of alluvium the newest formations containing organic remains and the newest formations still submerged by lake and sea, is both to deprive the word itself of almost all possible meaning or application, and to assign to these formations a place or character hitherto unknown to science and unprovided with a name. We therefore understand alluvium to be all the

newest aqueous deposits, made by river, lake, and sea, whether constituting actual land, or existing under water in a state of fitness to become soil.

The existing inequalities on the surface of the earth, and particularly the origin, the form, and the distribution of valleys, have been the subject of much controversy and very conflicting opinions among geologists. Yet after all allowance has been made for volcanic action, or the formation of islands, hills, and mountains, by the sudden eruption of concentrated, local, subterranean fire,—for plutonic action, or the upheaving of mountain ranges, and the diversified elevating of broad tracts of country, by the power of diffused subterranean fire,—for disruptive action, in the crash of the avalanche, the fall of the landslip, and the devastations of the earthquake,—and for diluvial action, in the breaking up of continents, the dispersion of islands, the throwing down of hills, the filling up of hollows, and the general physical revolution of the world by the general deluge,—all classes of geologists admit that a very large amount of the existing contour of the earth, and especially those features and lineaments of it which constitute the ramified basins of great rivers, must have been fashioned by the action of running water. In whatever condition the world was left by the general deluge, whatever effects it retained of the previous great volcanic and plutonic agencies, and whatever results it exhibited of the universal catastrophe which had just transpired, it cannot be imagined to have possessed the flowing outlines of valley and the nice adjustments of river-course which now characterize it, but must be figured to the mind as abounding in asperities, rugosities, spreading tableaus, and sharply angular masses, which only the erosions of the atmosphere, and the action of running water, could reduce to the existing condition of beautifully curved surface, and conveniently intricate division. “The first rains that fell, and the first springs which burst forth, would necessarily collect in the lowest levels, and thus the direction of the great trunk of a river would be determined; and it might also happen that other clefts—depressions at a higher level—would communicate with this main channel. But that every such great depression would have a direct communication with the sea, and that such a combination of subordinate valleys as compose a river system, could have been formed by the breaking up of the earth’s crust, either by elevation or subsidence, can hardly, we think, be maintained by any one. A river-course or system may be not inaptly compared to a picture of a great tree, whose branches gradually diminish in size, but increase in number, as they recede from the stem. The great trunk of the river is divided into many branches, which spring from it at various distances from one another; and these again are subdivided into an infinity of smaller ramifications, each diminishing in size as it increases in distance from the main trunk,—

a regular communication being kept up between every point and the line of greatest depression; forming together a system of valleys communicating with one another, and having such a nice adjustment of their declivities, that none of them join the principal valley either on too high or too low a level." The enormous number of subordinate valleys, amounting in each case to many hundreds, and in some cases to several thousands, in the basin of almost every one of even the third or fourth rate rivers of the world,—the occupancy of them all, from end to end, by streams of the same direction as themselves,—their perfect relationship to one another, the short and narrow to the next in extent, the next to the larger, and the larger to the chief,—their exact common adaptation, by elevation, ramification, and direction, to the purposes of a multitudinous system of water-course terminating in one main channel,—the slopes or declinations of their sides, seldom consisting of precipices or abrupt escarpments, and usually exhibiting the precise gradient which the long and silent abrasion of the running and wearing streams might be supposed to effect,—the occasional phenomenon of 'parallel lines' or equally elevated terraces at some height along their sides, or of one or more expansions and contractions of flat territory at some height along their course, marking the quondam existence of fluviatile lakes, which have long since burst through the barriers by which they were retained,—and the simple mineral constituency of the soils of the small and upper valleys, exhibiting the few elements of the rocks in the mountains at their head, the more compound mineral constituency of the soils of the secondary and lower valleys, exhibiting the elements of the rocks at the head of the connected series of upper valleys, and the thoroughly compound mineral constituency of the soils in the terminating part of the grand main-trunk valley, exhibiting the elements of all the rocks, and all the debris, and all the moveable organic remains of the whole of the multitudinous sections of the basin,—these are proofs which scarcely any man in his senses will resist, that the valleys of the world, as they at present exist, were scooped out and fashioned by the action of running water,—and they, at the same time, are important illustrations of the nature and formation of all the alluvium which constitutes a large and most important part of the soils of valleys.

The hard rocks which constitute the great mass of all mountains and hills, generally reach the surface of the heights which bound the upper parts of valleys, or are covered only by a very thin stratum of detritus and vegetable mould; wherever they are exposed to the action of the weather, they are constantly undergoing disintegration into new materials of detritus and debris; and so steadily and rapidly do they yield up new disintegrations to succeed those which are washed away by rains and torrents,

that most hill-summits may be ascertained to lose some inches of their altitude during any one man's lifetime of observation, and many have been observed to lose several feet during the period of comparatively very few years. Thunder-showers, ordinary rains, and the thawings of snow and ice, sweep down disintegrations and incipient soil from the summits of mountains to their sides; rills and torrents break up debris into smaller particles, and carry detritus and soils from the sides of mountains to the upper parts of the higher valleys; brooks, rivulets, and freshets, triturate the gravels and soils and coarse alluvium of the higher valleys into gritty or half-pulverized earths, and bear them along to the lower valleys; and streams, rivers, and occasional or seasonal inundations comminute the soils and earths of the lower valleys into silts or argillaceous sands, and either spread them athwart the low-lying fields and meadows as rich natural manures and top-dressings, or career away with them to the seaboard, to form deltas above the shore, or the ingredients of future land beneath the tide. A continual process is thus going on of depressing mountains, elevating valleys, transferring the soils of uplands to lower grounds, conveying the soils of low grounds to meadows, deltas, and the ocean, and, in general, forming belts, bands, and occasional expanses of new land along the course, and at the mouth, of most considerable streams, and nearly all large rivers. Now all these fluviatile formations, whether constituting the very surface of existing land, or retaining their original character in the position of subsoils, or lying at the bottom of estuaries and bays ready to become land when they so accumulate as to rise above the sea, are strictly alluvial; and many of the first class, or those which constitute the surface of existing lands, will instantly be detected by all sorts of farmers as identical with the richest meadow grounds and low-lying arable lands of England, and with the carse, the holms, and the haughs of Scotland.

The power of rain and rills to disintegrate and carry off the surface of the uplands round the head of valleys, is greatly aided by dews, fogs, thunder-showers, snows, frost, lichens, moss-plants, carbonic acid, and electricity; and this aid is vastly stronger, steadier, and more effective than a cursory thinker would conceive possible. Nor does this power operate only to break up and carry off the crust of the uplands, but it triturates and pulverizes the debris, diluvium, and transported gravels of the lower grounds, tears up and sweeps away coarse vegetation, and many organic remains, combines mineral matters with vegetable moulds, compounds all the transportable materials of uplands and lower grounds, of the hills and the middle valleys, into the constituents of a fine fertile soil, and sends down the whole in the ordinary currents of the main streams, and particularly in freshets and inundations, to constitute, athwart the meadows and

other low situations of the lower valley, a stratum of alluvial land. The force of running water, when directed against a natural embankment, or any other earthy or rocky obstacle in its course, is very considerable; and this force is greatly increased by the momentum of current down a steeply inclined plain, and by the presence in the current of a large mechanical mixture of sand and gravel. Large stones and pieces of rock are lighter in water than in air, to the amount of the weight of a mass of water equal to their own bulk; and they, in consequence, roll along the current of a river with remarkable ease and velocity, and are transported by floods to great distances, and occasionally deposited in extraordinary situations. But with how much greater ease, or in how much feebler conditions of fluvia, tile current, may detritus, soils, and earth-banks be worn into fragments, and carried headlong for many miles to be deposited athwart the surface of a valley, or the delta of a river! The most ordinary observer needs but to look at the effects of one day's common heavy rain, in order to see that hill-pastures are swept and washed like the pavements of a town, that newly tilled arable lands are deprived of their soil to the amount of several hundred weights per acre, that the banks and bed of streams are abraded and deprived of considerable portions of their substance, that loose and decayed vegetation in the wood and on the field is extensively carried off, and that the streams, in the middle and lower parts of their course, are red and turbid with the load of the accumulated spoils. When a stream flows at the rate of three inches in the second, it tears up fine clay; six inches in the second, fine sand; twelve inches in the second, fine gravel; and thirty-six inches in the second, beds of such loose stones as have each the size of a hen's egg. The power which results from these rates of velocity is quite common in the streams of hilly and undulated countries, and is far exceeded by many of the streams of mountainous regions; and it obviously could not have been constantly exerted during thousands of years, in lines at the mean distance from one another of only a few furlongs over the great part of the terrestrial world, without effecting great changes in the configuration of the earth's surface, and producing an enormous aggregate amount of alluvial deposit. Even in level countries, too, where the loss of power in a river is great from the diminution of its velocity, that loss is often very considerably compensated by the tortuosity of the river's course, the weight of its accumulated volume of water, and the frequent and heavy abrasion of its current upon protrusions and salient angles of the banks. The stream, on entering a plain, may run obliquely so as speedily to form a steep bank or vertical cliff; it deflects, or is flung off from this, and runs obliquely to a point on the opposite side, there also to form a steep bank or vertical cliff; it repeats this process at every one of its mazy

windings, or rather at every curvature of its sinuous course; and it in consequence rolls the whole weight of its large and heavy volume against a rapid series of salient angles, and carries on, from side to side, and from point to point of its banks, a constant and extensive process of undermining and erosion. When a tortuous river-course winds among solid rock, and constitutes a prolonged and stupendous ravine or natural canal, as in the case of the river Moselle, whose banks in some places are 600 feet in height, it affords the most forcible evidence of the great power of running water, and thoroughly exposes the absurdity of the theories which ascribe a chief part, or almost any part, of the configuration of valleys to the action of fire, or to mere disruption of the earth's crust.

In 1827, after a heavy fall of rain, the little Northumberland rivulet called the College, carried blocks of stone upwards of half a ton in weight two miles down its channel, and one block of nearly two tons in weight about a quarter of a mile. During the Moray flood of 1829, the river Nairn carried a block of sandstone rock, fourteen feet in length, three feet in width, and one foot in thickness, upwards of two hundred yards down its channel; and the river Don drove about 450 tons of stones, many of which were each from 200 to 300 pounds in weight, up an inclined plane of about ten yards in length, and six feet in ascent, and left them on a piece of flat ground in a heap of about three feet in height. The Niagara river in America wears so rapidly the precipice at its celebrated falls, as to have made the cataract recede about 150 feet during the last forty or forty-five years; and it flows for seven miles below the falls in a channel of about 150 feet in depth, and 480 feet in width, before debouching into a plain, and has evidently formed the whole of this long sweep of channel by the same process of erosion which continues to go on at the falls. The river Simeto, the largest stream in Sicily, was dammed up by a mass of lava from Mount Etna in 1603; and though the lava formed a rock nearly as hard and compact as basalt, the river has already worn through it a channel of from forty to fifty feet in depth, and from fifty to several hundred feet in width. The Nerbuddah, a river of Hindostan, has worn in a basaltic rock a passage of about an hundred feet in depth. The rivers of the eastern Alps have, in various instances, cut defiles and ravines through masses of coarse, horizontal conglomerate to the depth of 600 or 700 feet. The river Inn near Innspruck, and the river Drave between Klagenfurt and Marburg, have also cut enormously deep ravines through stupendous masses of solid rock. A temporary stream formed by the bursting of the barrier of a lake near Martigny in the Vallais, passed over a distance of forty-five miles to the lake of Geneva in five hours and a half; it swept away trees, bridges, and human habitations with

almost playful facility; and it tore up masses of rock as large as houses out of old alluvial land, and rolled them a quarter of a mile along the valley. In 1810, in the state of Vermont in North America, a lake, one mile and a half in length, three quarters of a mile in width, and from 100 to 150 feet in depth, suddenly made a breach in its barrier about a quarter of a mile in width, emptied all its contents in the course of a few minutes through the breach, tore up a channel a quarter of a mile wide, and from fifty to eighty feet deep, to a lower lake, drove down in a moment the lower lake's retaining mound or barrier, ploughed up a channel of from 300 to 600 feet in width, and from 20 to 60 feet in depth, along the bottom of a valley of five miles in length, and then divided itself into a number of divergent streams, and dispersed its spoils over an expanse of plain, yet, in one of its streams, retained so much power, at the distance of seventeen miles from the bed of the lake, as to transport a rock of about one hundred tons in weight several rods from its bed. These facts, to which thousands of similar ones might be added, may probably induce even the crudest observers to ascribe to the action of running water the configuration of a very large part of the present surface of the earth, and the formation or remodelling of a comparatively great amount of the existing arable land.

The bed of the burst lake in Vermont has now the appearance and character of a Scottish haugh; and the margins of its banks are parallel terraces of similar formation and outline to the celebrated 'parallel roads' of Glenroy in Inverness-shire. Numerous flats and meadowy levels in the valleys of hilly and undulating countries obviously seem to have, on the same principle, been beds of comparatively recent lakes; and not a few terraced lines along the sides of hilly-valleys, at considerable elevations above the height of the present water-courses, may be easily identified with the banks of ancient lakes. When a river passes through a lake on its way to the sea, it throws to the bottom all the heavier and larger particles of debris and diluvium brought down from the upper regions of the basin; and, if the lake be larger, the river, even though turbid and quite laden with silt, precipitates the very finest portions of its freight, and debouches from the lake in a state of as great limpidness and purity as many a rill does from a fountain. Hence, the haughs and meadowy expanses which formed the bottom of small lakes—provided other circumstances be equal—always possess a grittier or far less comminuted soil than such as were the bottom of large lakes. The river Rhone, on entering the lake of Geneva, is extremely turbid, but on effluxing is beautifully limpid; and it has for many ages—probably since the general deluge—been purifying itself by the same process, and making similarly large deposits of silt, as at present; it has already formed, immediately above

the existing head of the lake, a fine tract of alluvial land of nearly eight miles in length; and, if no serious disturbance should occur in the physical laws under which it is acting, it will eventually fill up the entire lake, even though 160 fathoms in depth, and will convert the whole of its area into an expanse of rich meadow. A large portion of the vast and luxuriant valley of the Rhine, upwards of an hundred miles in length, between Strasburg and Worms, and bounded on the one side by the Vosges mountain, and on the other by the mountains of the Black Forest, is occupied to a great and unknown depth by an alluvial deposit of exactly the same materials which continue to be borne along by the river, and very obviously appears to have been at one time the bed of a lake far more extensive than that of Geneva. Other though smaller expanses of lacustrine land occur in the higher parts of the Rhine's course; a considerable tract occurs at the head of the lake of Constance; numerous vast tracts, evidently coextensive with ancient lakes, occur along the course of the Danube, the St. Lawrence, and other great rivers; not a few tracts of manifestly lacustrine formation may be observed in the valleys of Great Britain and Ireland; and tracts of greater or less extent may be seen at the head of Loch Lomond, Lough Neagh, Loch Erne, and other British and Irish lakes.

When lakes do not exist in valleys, to serve as recipients of travelled gravels and silts from the upper regions of a basin, rivers make their chief deposits either along their own channels, or athwart periodically inundated plains, or athwart a low seaboard, or beneath the waters of the ocean. The Po, which has no considerable lake in its course, which receives the numberless torrents of the northern Apennines and the south side of the Alps, and which traverses the vast plain of Lombardy to the Adriatic sea, makes such deep and constant deposits along its channel that the neighbouring inhabitants have long embanked it to prevent inundations of their country, and are in the practice of transferring mud from its bottom to its banks, to the amount sometimes of one foot of depth in a season, and yet have been compelled progressively to increase the height and strength of the embankments, till at last all the lower part of the river's course has become a vast aqueduct along the summit of a stupendous artificial mound, so lofty as to overlook the tops of the houses of Ferrara.—The river Nile, as is well known, has, from the earliest ages, periodically irrigated all the inhabited part of Lower Egypt, supplied it with a rich alluvial soil, counteracted upon it all the effects of aridity and incessant drought, and maintained it in a condition of fertility wondrously in contrast to the dismal and universal barrenness of the adjacent deserts. This remarkable stream collects nearly all its waters and all its rich freights of comminuted soils and organic remains among the mountains and other uplands of the interior and

tropical regions of Africa; and, when the season of the tropical rains arrives, the stream increases in both volume and silt, and continues day by day to rise in its channel and become turbid in its waters, till it spreads like a sea over all the cultivated lands of Lower Egypt, refreshing the parched ground with moisture, and renewing the fertility of the exhausted soil by a new deposit of rich alluvial loam. Even the Ganges, though more remarkable for its delta and its submarine deposits than for its fertilizing inundations, annually overflows a vast tract of low country on both sides of its banks, renovating the land with a thick and fertilizing top-dressing of fresh alluvium, stimulating all the far-spread expanse into the utmost luxuriance of vegetation, and enabling it to produce valuable and varied crops of rice, wheat, barley, indigo, tobacco, cotton, and other cultivated plants.

Rivers which slowly descend to the sea across a low, broad, slowly-shelving seaboard, and which have little or no conflict with tidal currents, but enjoy permission to make their final deposits of sand and silt with deliberation and tranquillity,—such rivers have, in many instances, made large encroachments on the sea, and divided themselves into a divergent series of terminating streams, and formed, all round their streams and athwart their mouths, great expanses of low, level, alluvial land. In some instances, the two outer streams of the divided river constantly diverge from one another till they fall into the sea, and give to the district which they enclose the triangular outline of the Greek letter delta, Δ ; and hence first the enclosed districts, and next the entire expanses of low alluvial land at the mouths of rivers, are technically designated deltas; yet some of these expanses have a totally different outline from the triangular, and others are traversed and cut into a kind of stupendous network by innumerable subdivisions and cross-streams of the original river. The delta of the Ganges measures two hundred miles along its base, and the same distance from its apex to the sea; and, throughout its lower region, called the Sunderbunds, it is a wilderness of the rankest vegetation, infested by alligators and tigers. The delta of the Rhine is identical with a very large proportion of Holland; the delta of the Nile is identical with the main part of Lower Egypt; and the deltas of the Rhone, the Danube, the Po, the Indus, the Wolga, the Orinoco, and several other great rivers, are identical with some of the richest and most extensive regions of the inhabited and cultivated seaboard of the coasts to which they respectively belong. All the deltas are encroachments on the sea, and all the lacustrine alluvial lands are encroachments upon lakes; and several of both classes of formations have very greatly extended themselves within the period of European record. The city of Ravenna, for example, was formerly a sea-port of the Adriatic, but now stands four miles inland;

and the town of Port-Vallais stood, about eight centuries ago, on the margin of the lake of Geneva, but is now about a mile and a half distant from the nearest part of the lake.

The amount of alluvial deposits carried by rivers to the ocean is evidently enormous, and far exceeding what any superficial thinker would suspect; but, in the present blank condition of the statistics of physical geography, it cannot be proximately estimated. The Ganges colours the sea with mud to the distance of sixty miles from the coast, and is supposed to deposit daily beneath the tide a quantity of matter of equal bulk to the great pyramid of Egypt. The river Amazon, which is said to be forty miles wide at its mouth, and is computed to drain an extent of territory equal to five-sixths of Europe, colours the ocean with the mud of its waters to the distance of about three hundred miles from the coast. The river Orinoco discolours the ocean to probably two-thirds the same extent as the Ganges. Many broad bands of existing low country upon the coasts of continents may easily be seen, by their position, their elevation, their mineral constitution, and their quite recent marine remains, to have been formed by the fluvatile deposition of alluvium beneath the sea, and to have been, only one or two thousand years ago, or even but a few centuries ago, the beds of bays, estuaries, and far-extending inlets of the sea. Various bands, or long and sometimes curved belts of low land also, may easily be proved to have, at a comparatively recent period, been the bottom of straits and sounds, and to have been gradually filled up by fluvatile deposits till they united islands to a neighbouring continent. Existing bays, estuaries, marine inlets, and even seas are known to actual observation to be so rapidly and regularly filling up, that proximate calculations can be made of the future century or decade when all or parts of some will become impracticable to navigation, and when all or parts of others will be easily convertible into dry land by embankment, or will, without artificial aid, rise permanently above the tide. Several of the largest marine inlets of Great Britain, as the estuaries of the Forth, the Tay, and the Humber, are thus known to be rapidly filling up; and even the bed of the German ocean is ascertained to be steadily increasing in elevation. The alluvial silts held in mechanical mixture by tidal currents, and giving a constant tint of earthy redness to the waters of such estuaries as the Humber and the Solway, are often artificially made to overflow level coast-lands lying at an elevation below high-water mark, and are found to deposit, in a brief period, such a thick bed of fine alluvium as constitutes an entirely new and very fertile soil. See WARPING. Bars, shoals, and sand-banks are known by every mariner to be formed athwart the embouchure of every sea-entering river,—often with the effect of rendering navigable entrance difficult or im-

possible; and when these bars and other obstructions occur opposite a delta, they prevent much of the moving alluvium from passing out to sea, and occasion it to settle between themselves and the delta, and greatly to accelerate the formation of new land.

But the direct action of the sea, both in disintegrating rocks and soils, and in forming new deposits, is of enormous power and wonderful extent, and may be observed upon every district of coast in the world. Islands have been wholly destroyed; large limbs of continents have been washed away; large islands or considerable sea-board districts of continents have been broken up into groups of islets; broad and extensive regions of continuous coast have been dis severed into series of sea-lakes and peninsulæ; mountain masses of cliff and coast-rampart have been torn into fragments,—part of them left as stalks, and arches, and caverns, and the remainder triturated into grit and powder; and an incalculably large aggregate of low coast lands have been formed by mingled deposits of these various disintegrations, and of the alluvial muds and sands brought down by rivers. The rocky coasts of Cornwall, and still more the rocky islands of Orkney and Shetland, afford sublime examples of the terrific disintegrating power of the billows. The whole coast of Yorkshire, from the Tees to the Humber, and particularly from Flamborough-Head and Spurn-Point, is undergoing regular demolition at the average rate of several feet in the year. The coasts of Norfolk, of Suffolk, of Kent, of Sussex, and of Dorset, may almost be seen to crumble away beneath the eye of an occasional visitor, and afford many remarkable instances of quite recent and comparatively extensive demolition. A point in the harbour of Sherringham was, about sixty years ago, occupied by a cliff fifty feet in height and surmounted by houses, and is now a piece of sea sufficiently deep to float a frigate. All the site of the ancient little town of Cromer is now part of the bed of the German ocean. The town of Dunwich, formerly a place of great trade, a seat of large population, and the most extensive sea-port on the coast of Suffolk, has been washed down piecemeal by the sea till only the tiniest and most miserable vestige of it remains. The church of Reculver in Kent stood nearly a mile from the sea in the reign of Henry VIII., but is now within about sixty yards. The site of the old town of Brighton, in front of the existing Brighton cliff, has been wholly submerged. In the course of twenty-four hours in the year 1792, a part of the coast of Dorsetshire, about a mile and a quarter in length, and one-third of a mile in breadth, sunk fifty feet from its previous level. But—to quote stupendously larger, though not so certain instances—England is supposed to have formerly been united to France at the straits of Dover, Sicily is supposed to have been united to Italy at the straits of Messina, Ceylon is supposed to have been united

to the Indian continent across the series of shoals called Adam's Bridge, and the islands of Cuba, Jamaica, St. Domingo, and the Caribbees are supposed to be the fragments of a horse-shoe continent which enclosed the Caribbean sea in the manner of the Mediterranean. A very large proportion of the detritus of coasts, and the disintegrated contents of quondam districts and islands, must be supposed to be lodged in the deep parts of the ocean, there undergoing such processes of induration as formed our existing sedimentary rocks out of the debris of the primitive masses of our world; yet a considerable proportion obviously combines with comminuted shells and decayed fuci, and the mineral and vegetable silts brought down by rivers, to form the great tracts of rich low land which lie along many stretches of coast, and are occupying the places of former bays and gulfs.

The composition of alluvium is exceedingly various, and depends partly on the mechanical conditions under which it was deposited, but principally on the character of the rocks, soils, and other surfaces whence its materials were obtained. Such alluvium as was deposited in still water is much more argillaceous and far more finely pulverized than if it had been deposited by eddies, rapid currents, or turbulent waters; and such as was deposited under a slow, regular, and very prolonged process, is incomparably more uniform in both composition and texture, than if it had been deposited by the bursting of a lake or any other single, extraordinary, or violent action. Alluvium from the debris of a limestone basin will be found predominantly calcareous; from the debris of a micaceous and softly granitic basin, predominantly argillaceous; from the debris of a greenstone or basaltic basin, predominantly loamy; from the debris of a quartzose and sandstone basin, predominantly silicious; from the debris of a rocky basin, predominantly mineral; from the debris of a diluvial basin, characteristically full of decayed vegetable fibre; and from the debris of coasts and islands, characteristically marked with calcareous sand or comminuted shells. Yet the great majority of alluvial lands are so exceedingly diversified in the mechanical conditions under which they were formed, and particularly in the sources whence their materials were derived, and the agencies by which these materials were pulverized, compounded, and modified, that they cannot be referred to any one type, but may be regarded as severally representing nearly all the varieties of simple soils. Most are fertile; a large proportion are eminently rich; and not a few are wonderfully deep. No definite number of analyses, of course, can afford an index to the character of each particular alluvial formation; yet three analyses made by Sir Humphrey Davy may be quoted as illustrations, in a general manner, of the wealth of alluvial soils. A specimen from the banks of the river Parrett, in Somersetshire, yielded eighty

parts (we presume eighty per cent.) of finely divided matter, and one part of silicious matter; and an analysis of the finely divided matter gave 360 parts of carbonate of lime, 25 parts of alumina, 20 parts of silica, 8 parts of oxide of iron, and 19 parts of vegetable, animal, and saline matter. A specimen of rich soil from the neighbourhood of the Avon, in the valley of Evesham, in Worcestershire, consisted of three-fifths of fine sand, and two-fifths of impalpable matter; and an analysis of the latter gave 41 parts of alumina, 42 parts of silica, 4 parts of carbonate of lime, 5 parts of oxide of iron, and 8 parts of vegetable, animal, and saline matter. A specimen of excellent meadow soil, from the valley of the Avon, near Salisbury, afforded one-eleventh of coarse silicious sand; and its finely divided matter consisted of 7 parts of alumina, 14 parts of silica, 63 parts of carbonate of lime, 2 parts of oxide of iron, and 14 parts of vegetable, animal, and saline matter.—*Lyell's Elements of Geology*.—*Lyell's Principles of Geology*.—*Buckland's Geology*.—*De La Beche's Geology*.—*Burnet's Theory of the Earth*.—*Sir H. Davy's Agricultural Chemistry*.—*Philip's Geology*.—*Comstock's Geology*.—*Malte Brun's Geography*.

ALMOND,—botanically *Amygdalus*. A genus of fruit trees and ornamental shrubs, with rosaceous blossoms. It includes the peach, the nectarine, the sweet almond tree, the bitter almond tree, and four species of ornamental shrubs; and it was formerly regarded by all Jussieuan botanists, and is still regarded by some as a member of the Rosaceæ family; but it more properly constitutes the type of a distinct order, called Amygdaleæ, Amygdalineæ, or Amygdalaceæ, and embracing the plum, the damson, the cherry, the bird-cherry, the sand-cherry, the bastard-cherry, the choke-cherry, the common laurel, the Portugal laurel, the bullace tree, the apricot, and the numerous other species of the genus *prunus*. The fruit of all the plants of amygdaleæ is a drupe; the leaves of all contain some portion of prussic acid; and the bark of most or all yields a gum similar to gum arabic, and an astringent, febrifugal substance similar in medicinal virtue to Peruvian bark. The species of the genus *Amygdalus* are the peach, the sweet almond, the common dwarf, the woolly, the silver-leaved, and the double-dwarf.

The peach, *Amygdalus Persica*—but now called by some botanists *Persica vulgaris*—is a native of Persia, and was introduced to Great Britain in 1562. It has usually, since the time of Linnæus, been divided into two varieties,—the peach, with downy fruit,—and the nectarine, *Amygdalus Persica nectarina*, with smooth fruit,—the latter now sometimes called *Persica lævis*. Yet various instances have occurred of the two varieties of fruit growing on the same tree, and even on the same branch; and one instance is on record of a single fruit being partly peach and partly nectarine. The French divide the fruits of the spe-

cies into péches, free-stone peaches, whose fleshy matter easily separates from the stone and the skin; péches lisses, free-stone nectarines, or free-stone smooth peaches; pavies, cling-stone peaches, whose fleshy matter does not easily separate from the stone and the skin; and brugnons, nectarines or cling-stone smooth peaches. See articles PEACH and NECTARINE. The double-flowering peach, *Amygdalus Persica plena*, is usually propagated for ornamental purposes, and is universally acknowledged to be one of the most handsome blossoming trees in either woodland or shrubbery, or against a wall. It flowers in spring, three weeks later than the single peach; and it attains a height of about fifteen feet. A double-flowering almond, almost certainly a peach, is noticed by a correspondent in a recent periodical as having produced flowers of the appearance of double roses.

The sweet almond, *Amygdalus communis*, is a native of Barbary, and was introduced to Great Britain in 1548; but it has long been naturalized in almost every district of the south of Europe, and in many districts of the temperate part of Asia. It is grown in Italy, Spain, the south of France, and different parts of the Levant, for its fruit; but it is cultivated in England only as an ornamental tree. Its fruit is produced in great abundance on most of the seaboard districts of the Mediterranean; and forms an extensive article of commerce, both in itself, and in the well-known oil which it yields. The Jordan almonds, which are the best, come from Malaga in Spain. Though but one in species, it has sported itself into a considerable number of well-defined and permanent varieties. One of the most remarkable of these, the bitter almond, *Amygdalus communis amara*, is distinguishable from the sweet almond only by the taste of its fruit, and yet it possesses the dismal property of always containing a very pernicious amount of prussic acid. Indeed it is doubtful whether these two kinds of almonds, the bitter and the sweet, are not furnished by the same variety of tree. It has been stated, apparently on good authority, that bitter almonds are not unfrequently gathered from the sweet almond tree. The bitter almonds are imported chiefly from Mogadore. Upwards of twelve ordinary varieties are cultivated in France; and also a hybrid kind between the common almond and the peach. Most of the varieties cultivated in Britain attain a height of about fifteen feet, carry a profusion of delicate red blossoms in March, and, both on their own account and from the contrast of the prevailing state of vegetation at the season, are eminently ornamental. The white-flowering variety is inferior in beauty to the others, and is liable to be stripped of its blossoms by one night's frost.

The common dwarf almond, *Amygdalus nana*, is a native of Russia, and was introduced to Great Britain in 1683. It grows usually to the height of only about two feet, but occasionally

to the height of four or five; and it produces handsome red blossoms in March and April. The single-flowering variety of it is eminently beautiful; but the double-flowering variety is quite exquisite. In both, the flowers are arranged over the whole length of the previous year's shoots.—The woolly almond, *Amygdalus incana*, is a native of the Caucasus, grows two feet high, and blooms in March and April.—The silver-leaved almond, *Amygdalus orientalis*, is a native of the Levant, and was introduced to Great Britain in 1756. It is much less hardy than any of the other species. It grows ten feet high, and blooms in March and April. Its leaves have on both sides a silver-coloured down, but do not appear till the flowers have fallen.—The double-dwarf almond, *Amygdalus pumila*, but called by some botanists *Prunus sinensis*, is a native of China, and was introduced in 1683. It grows four feet high, blooms in May and June, has a double as well as a single variety, and disputes with the common dwarf the praise of beauty.

All the species of almond may be propagated by budding, in July or August, upon peach or plum stocks. The plants intended for stocks ought to be planted in the nursery, when of the size of a straw; and, in the following summer or the next again, they will be ready to receive the bud. If the usual method of budding be practised, the risk of failure is exceedingly small; yet the double-blossomed peach ought always to be worked into stocks of the mussel plum. "The next spring, when the buds shoot," says Miller, "you may train them up either for standards, or suffer them to grow for half-standards, according to your own fancy; though the usual method is to bud them to the height the stems are intended to be, and the second year, after budding, they may be removed to the places where they are to remain. The best season for transplanting these trees, if for dry ground, is in October, as soon as the leaves begin to decay; but for a wet soil, February is much preferable; and observe always to bud upon plum-stocks for wet ground, and almonds or peaches for dry." The dwarf species may be propagated also by layers or by suckers.

Almond oil is obtained from the several varieties of the common almond; and is the same in quality from them all, but exists in smallest proportion in the bitter variety. The sweet almond contains about 54 per cent. of this bland fixed oil, with about 24 per cent. of a soluble albumen termed *emulsin* or *synoptase*. The cake left after the expression of the oil forms what is called almond powder, which is a good cosmetic for keeping the skin of the hands soft. This oil is used for emollient purposes in medicine; and, in certain cases, is administered in large doses to arrest inflammation in the stomach. It is thinner, sweeter, and less liable to rancidity than olive oil; and hence is generally used in perfumery, and for all purposes in which a very fine oil is required. *Macassar oil* is merely oil of almonds,

coloured red with alkanet root; and *Russia oil* is the same thing, perfumed with ottar of roses, and rendered of a milkish white colour by potash or ammonia. Almond oil is used also by draughtsmen, for tracing drawings on common letter paper. The nostrums for eruptions and cutaneous disorders, sold under the names of *Milk of Roses*, *Kalydor*, and *Gowland's Lotion*, consist of emulsion of almonds with oxymuriate of mercury, sugar of lead, or white oxide of bismuth; and, though they might be gently emollient if they consisted merely of the emulsion, they exert, in their other ingredients, such a stimulating and corrosive power as cannot fail to be injurious. Bitter almonds, in consequence of their containing a comparatively large proportion of prussic acid, cannot be taken in more than a very small quantity without producing head-ache, vertigo, and more serious symptoms. The quantity of almonds imported into Great Britain in 1841 was 11,089 cwts.; in 1842, 21,335 cwts.—*Loudon's Encyclopædia of Plants*.—*Miller's Gardener's Dictionary*.—*Marshall on Planting*.—*Loudon's Gardener's Magazine*.—*Stevenson and Churchill's Medical Botany*.—*Dunghison's Materia Medica*.

ALNUS. See ALDER.

ALOE. A very numerous genus of tender ever-green plants, presenting considerable resemblances to the types of several of the Jussieuan orders, and referred by some modern botanists to the Asphodel type, and by others to the Day-lily type. The total number of known species is nearly one hundred and twenty; and the number introduced to Great Britain is about one hundred. Unsuccessful attempts have been made by several botanists to divide them into a considerable number of genera. They are plants of very singular appearance; and may, as to the oddity of their form, be placed in the same category with New Zealand flax, Adam's needle, and the American aloe. Some may be classed as small trees, some as shrubs, and most as ever-green herbs. Five or six are natives of respectively China, the East Indies, the Mauritius, Eastern Africa, and the Levant; but all the others are natives of the Cape of Good Hope. By far the majority are mere vegetable curiosities; but several are planted as hedges in the West Indies and the Cape of Good Hope, the fibres of several are manufactured into cordage and coarse cloth, the pulp of one is used by the Hindoos as a principal ingredient in a cooling beverage, and the juice of five or six yields the well-known aloes of commerce and of medicine.

The soccotrine species, *Aloe soccotrina*, which has the reputation of producing the best aloes, has, when old, a round stem, three or four feet high,—sword-shaped leaves, eighteen or twenty-four inches long, saw-edged, sharp, and rising in clusters from the top of the stem,—and flowers of a red colour tipped with green, and arranged in clusters along the upper part of lofty flower-stalks which soar vertically from among the leaves.

This species takes its name from the island of Soccotra in the Straits of Babelmandel; but it is also, and more abundantly, a native of the Cape of Good Hope; and is very extensively cultivated for its juice in the West Indies. The kind of aloes called Soccotrine is made chiefly from *Aloe soccotrina* and *Aloe spicata*; and, in common with the former of these, it derived its name from being first produced in the island of Soccotra. *Aloe spicata* is extensively cultivated at the Cape of Good Hope; and it there yields a large proportion of the soccotrine aloes of commerce. The species *vulgaris*, *purpurescens*, *arborescens*, and *soccotrina*—though these are regarded by some botanists as only varieties of one species—are cultivated in Barbadoes and other islands of the West Indies, for the production of the kinds of aloes known in commerce as Barbadoes, hepatic, and horse aloes. The information which we possess as to the sources of aloes is still unprecise. Within a few years the drug has been imported into England from Bombay, Arabia, Soccotra, Madagascar, the Cape of Good Hope, the Levant, and the West Indies. Most writers state that all the aloes of the shops are obtained from varieties of the genus nearly related to the species called *Aloe perfoliata*; but the probability is, that aloes might be easily and plentifully manufactured from any of the species which have thick succulent leaves and an arborescent stem; and the number of such species, irrespective of varieties, is about thirty-four.

Lands on the immediate sea-coast, and subject to considerable drought, are esteemed the best for the profitable cultivation of the aloe. The soil is freed from stones and slightly ploughed; and the young plants are set like cabbages, at about six inches from one another, in rows a foot asunder. Almost any time in the year will do for planting; but the usual time is from April till June. The plants do not arrive at perfection till the second or third year; yet are usually cut down within the first. The labourer who cuts the plants is provided with a number of small tubs; he, with one hand, lays hold of a bunch of leaves as near the surface of the earth as possible, and, with the other, cuts them through; he instantly deposits handful after handful in the small tubs till all are filled; and he then goes over them in the order in which they were filled, finds the juice sufficiently exuded from the leaves, takes the leaves lightly out and returns them to the ground as manure, and empties the juice into a jar which holds from four to five gallons. The workman repeats this process till his jar is filled; and he has then been occupied from six to seven hours, and has performed his day's work. As the juice will keep for two or three weeks without injury, it is placed aside till a sufficient quantity for boiling is accumulated; and it is then boiled till it becomes sufficiently inspissated, and acquires the capacity of a resinous consistence. But various other modes of manufacture are practised

both in Hindostan and in the West Indies; and particularly a very tedious method of obtaining very fine qualities of aloes by inspissation without fire-heat.

Soccotrine aloes is a glossy semi-transparent substance, glittering and blackish in the mass, of an orange or reddish-brown colour with a purple cast in small pieces or when held between the eye and the light, and of a bright golden colour when reduced to powder. It is hard and brittle in a low temperature, and yielding and disposed to melt in warm weather; and becomes soft under the heat of the hand. The fracture is smooth, glassy, conchoidal. It has an intensely and enduringly bitter taste; and, though somewhat aromatic, is excessively nauseous. The boiling of two ounces of it in a pint of water, will show, in any case, to what degree it is adulterated; for all the pure aloes will be dissolved, and the impurities will remain in the form of earths, powders, or resin.—Barbadoes aloes is a substance varying from dark brown to liver colour, with an unctuous feeling and a strong smell; and is not easily broken, and has usually a dull fracture. The powder is of a dull olive-yellow colour; and the odour is very disagreeable. It is little used except for horses. The Cape aloes, as a distinct sort, is a darker coloured substance than the Barbadoes, has a stronger smell, is very brittle, shows a glossy or shining resinous fracture, and possesses considerable resemblance to the Soccotrine. The Cape and the Barbadoes, however, are often melted together into one mass, so as to lose all their distinctive properties; and all varieties of the two, but particularly this mixture of them, and all sorts of powdered aloes, are often adulterated with resin, lamp-black, charcoal, and other substances; but may easily be tested by the boiling of a small quantity in water. It is questionable whether aloes contains either gum or resin. Its most important constituent is a bitter extractive matter termed *aloesin*, which, according to Traumsdorf, forms 75 per cent. of Soccotrine aloes and 81.25 of Barbadoes aloes. It yields its medical virtues to cold water, and is extensively used as a vegetable cathartic.

Soccotrine aloes are very uncertain in their effects on cattle, and altogether unsuited to veterinary practice; but are very extensively used, both by physicians and by empirics, in the composition of drugs, especially pills and tinctures, for the human subject. But they are so very active and peculiar a medicine as to require, in every case, thorough scientific control, and, in most cases, a strong modification by accompanying drugs. They formed the sole ingredient in Anderson's pills, which were so long in vogue throughout the lowlands of Scotland; they constitute a chief part of the notorious Morrison's pills, which have scarcely yet gone out of fashion throughout Great Britain; and they are almost universally diffused among the huts and cabins and bogs of some parts of Ireland, as the starving

peasant's panacea for all human diseases. In all such cases as these, or any others in which the regular physician does not prescribe, Soccotrine aloes are a decidedly dangerous drug.—Barbadoes aloes is the most suitable for all departments of veterinary practice. In the case of black cattle and of sheep, however, it is of very doubtful action, and might, except in rare cases, be very advantageously banished from among the cattle-doctor's remedies. Six ounces have been given, in some cases, without any perceptible effect, and, in others, with only the mischievous effects of irritation and fever. They appear to force their way into the rumen; and they have there no power to act as an aperient or a sanative, but can only produce disgust and nausea. Aloes ought never to be administered to black cattle or sheep, as a first remedy or uncombined; and, even in cases of obstinate constipation, it ought to be given with caution, in perfect solution, and in mixture with such substances as epsom salts, tincture of ginger, and mucilage of gum arabic.—Aloes is incomparably the best purgative for the horse; and the Barbadoes purge more, gripe less, and maintain a longer action than the Cape. "In the proportion of fifteen ounces of the powder mixed with one ounce of powdered ginger, and beaten up with eight ounces of palm oil, and afterwards divided into the proper doses, it will form a purging mass more effectual, and much less likely to gripe, than any that can be procured by melting the drug. If the physic is given in the shape of a ball, it more readily dissolves in the stomach, and more certainly and safely acts on the bowels when mingled with some oily matter, like that just recommended, than when combined with syrup or honey, which are apt to ferment, and be themselves the cause of gripes. It is also worse than useless to add any diuretic to the mass, as soap or carbonate of soda: the action of these on one set of organs will weaken that of the aloes on another." The combination of any alkaline matter with aloes quickens their action, but impairs their purgative powers, and prevents them from operating specifically on the larger intestines. The activity of a dose of aloes to the horse may, when desirable, be increased by the addition of a few drops of creton oil.—A tincture of aloes and myrrh, made of eight ounces of powdered aloes, one ounce of powdered myrrh, two quarts of rectified alcohol, and two quarts of pure water, daily shaken for a fortnight, and then purified by filtration, is an excellent application for either old or recent wounds, not only acting as a gentle stimulant, but forming a thin crust over the wounds, and protecting them from the action of the air.—*Milburn's Oriental Commerce*.—*Porter's Tropical Agriculturist*.—*Materia Medica of Hindostan*.—*Duncan's Dispensatory*.—*Clater's Cattle Doctor*.—*Youatt on Cattle*.—*Youatt on the Horse*.—*Anderson's Commercial Dictionary*.—*Quarterly Journal of Agriculture*.

ALOES. See ALOE and ALOE-TREE.

ALOE-TREE,—botanically *Aquilaria Malaccensis*. A rare and interesting tree of China and of some of the East Indian islands, producing the aloes of scripture, and the aloes-wood, ligne aloes, eagle-wood, calambouc, and tambac of commerce. It resembles the olive-tree both in height and in form. The exterior part of the timber furnishes the eagle-wood of commerce; and is black, compact, and heavy. The part within the eagle-wood is the calambouc or calamba-wood of commerce; it is dark-coloured, shining, fragrant, exceedingly light, and burns like wax; and it is imported into Europe, and held in high esteem for its delicious odour and for the making of pastiles. The heart-wood or that which lies next the pith, is the tambac of commerce, and far more valuable than even the calambouc; but it is very difficult to be obtained, even in the countries in which it is produced. Both the tambac and the finer sorts of the calambouc are frequently sold in the East for their weight in gold, to be burnt in censers like incense. Two most beautiful passages in the sacred scriptures, afford an exquisite illustration of these fragrant aloes-woods, and lift them into association with the most glorious of truths: "Thou lovest righteousness, and hatest wickedness; therefore God, thy God, hath anointed thee with the oil of gladness above thy fellows; all thy garments smell of myrrh and aloes and cassia, out of the ivory palaces whereby they have made thee glad." "Thy plants are an orchard of pomegranates, with pleasant fruits; camphire, with spikenard; spikenard and saffron; calamus and cinnamon, with all trees of frankincense; myrrh and aloes, with all the chief spices; a fountain of gardens, a well of living waters, and streams from Lebanon."

ALONSOA. A small genus of tender, ornamental plants, of the nightshade or potatoe tribe, from Chili and Peru. The number of species introduced to Britain is five; and the total number known is nine. One of the species, *Alonsoa creticum*, has recently become a pet-plant with almost all florists.

ALOPECURUS,—popularly FOXTAIL-GRASS. A genus of grasses of the *Agrostis* tribe. The number of indigenous species in Great Britain is six; the number of introduced exotic species in 1829 was two; and the total number of known species is upwards of twenty. The two introduced exotic species are the bladdered, *Alopecurus utriculatus*, from Italy; and the black, blackish, or black-headed, *Alopecurus nigricans*, from Siberia. Of the indigenous species, the bulbous, *Alopecurus bulbosus*, grows wild in salt marshes in England; the meadow, *Alopecurus pratensis*, in meadows in England and Scotland; the Alpine, *Alopecurus alpinus*, on mountains in Scotland; the slender, *Alopecurus agrostis*, at roadsides in England and Scotland; the knee-jointed, jointed, floating or awned, *Alopecurus geniculatus*, in meadows in England and Scotland; and the

short-awned or orange-spiked, *Alopecurus fulvus*, in ponds in England. The bladdered and the slender are annuals; and the other six species are perennials. The species which make the strongest demand on our attention, and which we shall more particularly notice, are the slender, the bulbous, the knee-jointed, the meadow, and the black-headed.

The slender foxtail-grass, *Alopecurus agrostis*, is one of the very worst species; it produces no herbage of any economical value; it is untouched by every description of live stock; and it often flourishes as a very troublesome weed among wheat, and is abhorred by farmers under the name of black bent. Its seed is very abundant, and serves as acceptable food to pheasants, partridges, and the smaller birds. It is distinguished from *Alopecurus pratensis*, the most useful species of foxtail-grass, by the total absence of woolly hairs from its spike. It flowers in the first week of July, and onward thence till October; and, when grown on sandy loam, it yields per acre 8,167 lbs. of green produce, and 3,165 lbs. of dry produce, and only 223 lbs. of nutritious matter. This worthless and annoying species prevails in poor soils, especially when they have been exhausted by avaricious cropping; and it resists, and more or less defeats, every kind of effort for its extirpation, except the prosecution of a wise and fertilizing rotation of crops. "It will be found a vain and unprofitable labour," says Mr. Sinclair, "to attempt the removal of this grass by any other means than the opposite to that which gave it possession of the soil, which is judicious cropping. To return land in this state to grass, in the hope of overcoming this unprofitable plant, will be found of little avail. I have witnessed this practice; and the slender foxtail, instead of disappearing in these instances, reappeared with the scanty herbage, and in greater health and abundance. The soil must first be got into good heart by very moderate and judicious cropping, which includes the proper application of manure, a skilful rotation of crops, and the most pointed attention to the destruction of weeds; which last can only be effected, in this sense, by adopting the drill or row culture for the crops. After this, the land may be returned to grass for several years, with every prospect of success." The slender foxtail, while growing, sends forth flowering culms from the first week of July till the season of frost; so that, though repeatedly cut in one season, it suffers no material injury to its vitality or its powers of reproduction.

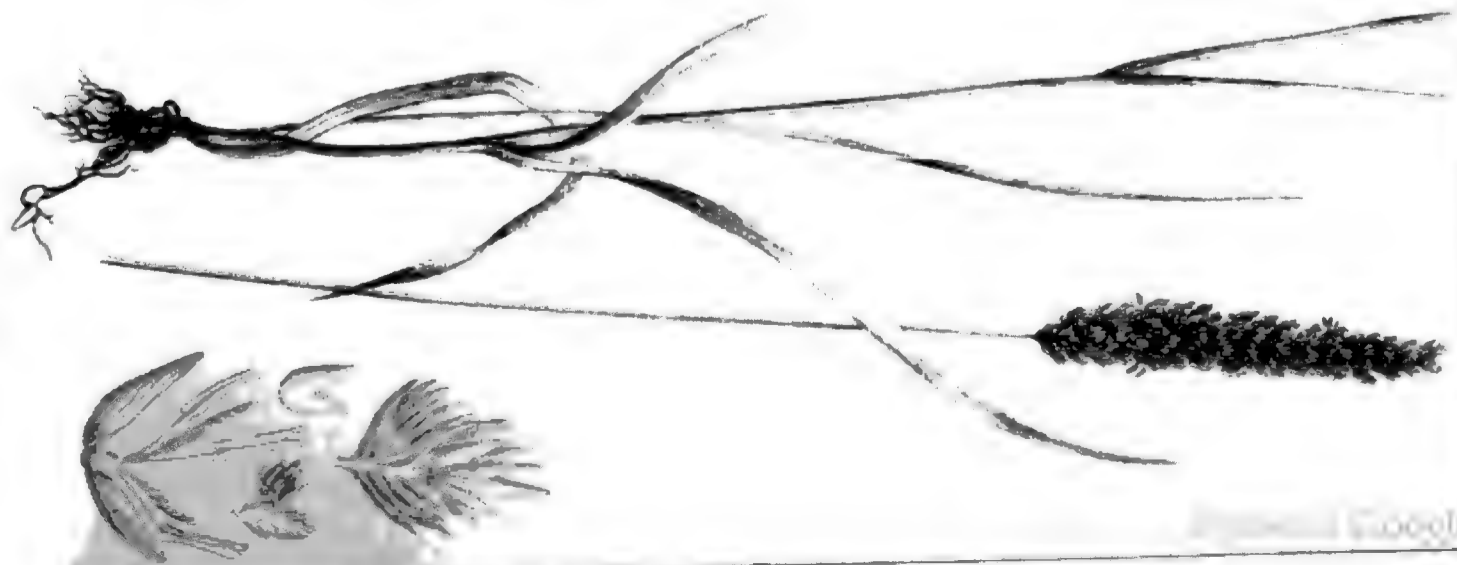
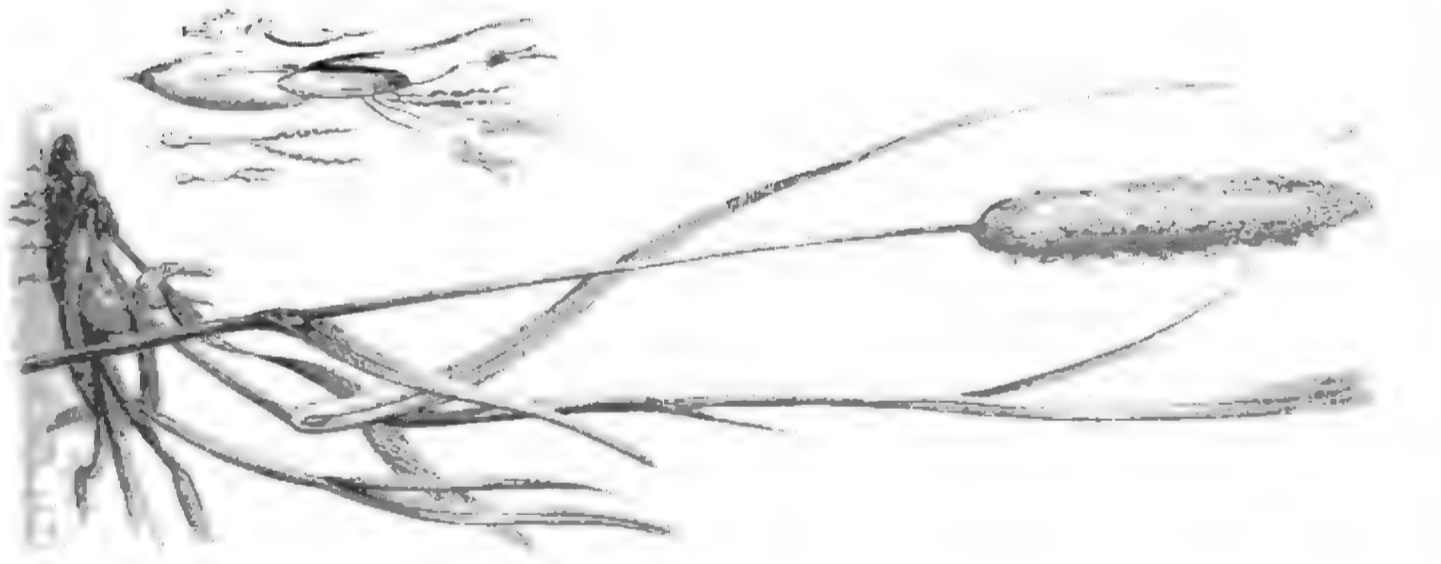
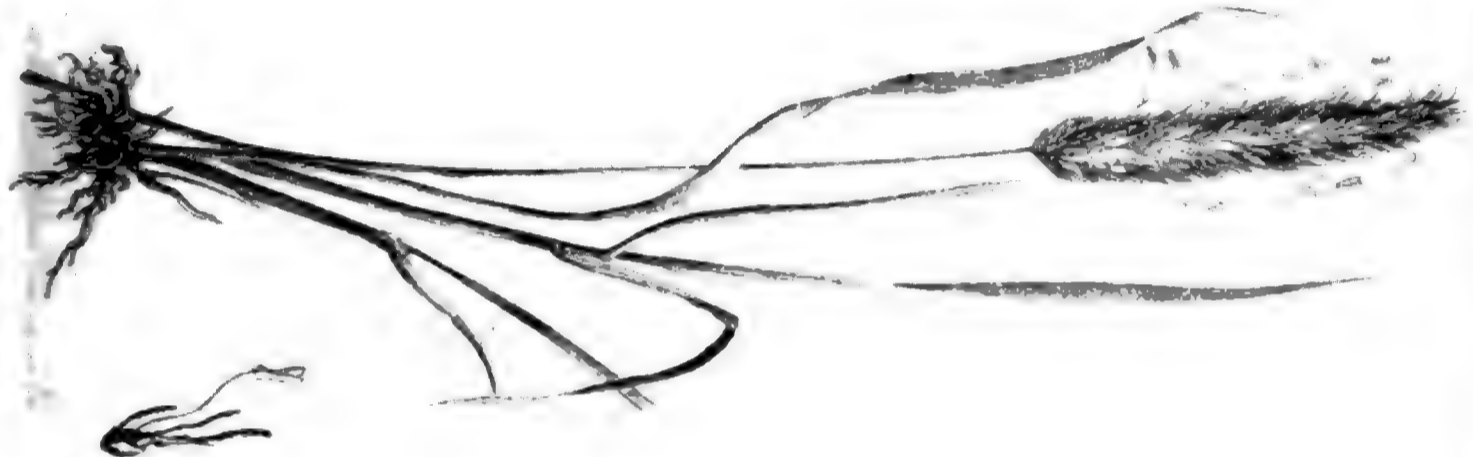
The bulbous foxtail-grass, *Alopecurus bulbosus*, appears to be but a degree less worthless than the slender species; but, in consequence of its fondness for salt marshes, it does not intrude upon the important situations of a farm in the troublesome and mischievous fashion of the other. A well-defined and permanent variety of the knee-jointed species,—the bulbous-rooted, knee-jointed

foxtail-grass, *Alopecurus geniculatus bulbosus*—is very liable to be mistaken for the bulbous foxtail-grass. This is distinguished from the true *geniculatus* by having a bulbous root; and by growing on a much drier soil. But it possesses so comparatively small a proportion of nutritive matter, as to be nearly useless to the farmer.

The prevailing variety of knee-jointed foxtail-grass, *Alopecurus geniculatus*, is a fibrous-rooted perennial, of taller growth. See Fig. 3. Plate VI. It occurs very frequently in the surface drains of meadows, and at the entrance of cattle-ponds; and is specially abundant in these situations upon clayey soils. It seems to be but little relished by either horses, cows, or sheep. Its proportion of nutritive matter is comparatively small; and its fondness for very moist soils renders it unsuitable for cultivation. It begins to flower in June, and continues to flower till the end of summer. The *Alopecurus geniculatus bulbosus*, when in flower, and when grown upon sandy loam, yields per acre 5,445 lbs. of green produce, and 1,089 lbs. of dry produce, and only 85 lbs. of nutritive matter.

The black-headed foxtail-grass, *Alopecurus nigricans*, was introduced to Great Britain so recently as the year 1815, and promises to be of considerable importance among the gramineous productions of British farms. It thrives in good loams, or in rich silicious soils containing a competent mixture of argillaceous matter; and, if merely sown on the surface, and not compressed, it grows with facility and luxuriance. W. P. Taunton, Esq., of Ashley—in honour of whom the species is sometimes called *Alopecurus Tauntoniensis*—made experimental sowings of it in 1841, upon strong woodsour clay over chalk, in a tolerably well sheltered situation, but without any extraordinary manuring, and at an elevation of some 500 or 600 feet above the level of the sea; and he found that, before the close of April, some of its stalks were in flower, and had attained a height of upwards of three feet; and he was induced to say respecting it, in a letter to the secretary of the Royal Agricultural Society of England, "Its bulk, hardihood, succulence, and precocity, inspire me with the hope that the committee will think that, in pursuing the culture of this grass, I shall be making a useful acquisition to English husbandry." Though it comes into flower in the end of April or the beginning of May, it continues to send up flowering culms till October; so that, while distinguished for the remarkable earliness of its herbage, it also produces as much late herbage as some of the best grasses which do not flower till a late period in summer. Its roots are very slightly yet quite evidently stoloniferous or creeping; and, though they in consequence unfit it for some of the most prominent purposes of the system of alternate husbandry, yet they very specially and eminently qualify it for others; for they are just stoloniferous enough to secure the continuance and ex-

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Andropogon scoparius

Andropogon scoparius

Andropogon scoparius

Andropogon scoparius

tension of the plant, without producing such encumbering and exhausting effects as result from the roots of *Triticum repens*, *Holcus mollis*, *Poa pratensis*, and other powerful creepers. Three ounces and four grains of nutritious matter were obtained by analyses from sixty-four drachms of *Alopecurus nigricans*; two ounces and fifteen grains from the same quantity of *Alopecurus pratensis*; three ounces from the same quantity of *Festuca heterophylla*; and four ounces and fourteen grains from the same quantity of *Triticum elongatum*; and, what materially adds to the comparative effect of these results, the *Alopecurus nigricans* used in the analysis was in flower, and the other three grasses were ripe.

The meadow foxtail-grass, *Alopecurus pratensis*, is a native, not only of Britain, but of most parts of Europe, and particularly of Italy, France, Germany, Holland, Denmark, Norway, Sweden, and Russia. It constitutes the principal herbage in many of our rich natural pastures, and may easily be distinguished from the other species of *Alopecurus* by its superior size,—from *Phleum pratense*, which it somewhat closely resembles, by its having only one palea, and from its beard being attached to the base of its palea and not to its glumes,—and from all other British grasses, by its flowers growing in close cylindrical heads, and consisting of two equally sized glumes, and a keeled and compressed figure enclosing a single palea. It is one of the earliest and most valuable of our native grasses, vegetates with extraordinary luxuriance, and yields a large produce both as a first crop and as aftergrass. Its root-leaves are very broad, long, soft, and slender; and, when eaten down by live stock, they grow again with great rapidity. Yet it is better adapted for pasture than for hay; for its culms are far from being proportionate in number or bulk to its root-leaves, and are sparingly furnished with side foliage. But whether used as pasturage, as green fodder, or as hay, it is much relished by sheep and horses, and seems far from being unacceptable to cows and oxen. Its seeds are produced in great abundance; and in consequence of its overtopping most other grasses, they may easily be gathered while the crop is growing; but they are seldom found in hay, for they generally ripen and fall before the other grasses are ready to be mown. It is exceedingly luxuriant under irrigation, keeps possession of the crowns of the ridges, and retains so strong possession of the soil as to be eminently perennial. When grown on a sandy loam, and combined with nothing but white clover, it yields sufficient pasturage during the second season to support per acre five couples of ewes and lambs. It does not acquire its full productiveness till the fourth year after being sown; and hence is inferior to many other grasses for alternate husbandry, or for brief periods of pasture; but it is excelled by no grass in aggregate value for strictly permanent pasture, and ought never to

bear a smaller proportion than one-eighth in any mixture of grass seeds for a sowing intended to remain during a considerable number of years. It requires, however, to have a loamy or meadowy soil,—decidedly good land, of medium character for moistness; and loses very much of its value, as to both bulk and nutritiousness, when grown upon any poor dry soil. Its produce on a clayey loam is nearly three-fourths greater than on a silicious soil; and the quality of this produce is also superior in the proportion of about three to two. It flowers in April, May, and June, according to the period up to which it has been depastured; and it ripens its seeds in June and July, according to the period at which it has flowered. Its produce in lattermath exceeds its produce in the flowering crop, in the proportion of about four to three. Its produce per acre, when grown on silicious sand, and when it is in flower, is 8,507 lbs. of grass, 2,552 lbs. of hay, and 133 lbs. of nutritious matter; but when grown on clayey loam, and when in flower, 20,418 lbs. of grass, 6,125 lbs. of hay, and 478 lbs. of nutritious matter.

The author of 'British Husbandry,' after briefly noticing the meadow foxtail-grass, *Alopecurus pratensis*, says, "There are two other species of the fox-tail, which all flourish chiefly on strong moist soils; but, although each bearing nearly the same character, this is the best. Mr. Taunton says, that on his dry ground he found them all considerably weakened, and that one of them, a German black-seeded species, had nearly disappeared; but where they were mixed in a meadow on clay, with a dark moory mould on the surface, they each maintained their size and bulk as well, or better, than any other grass. They indeed grow to great perfection on all moist loams and clays; and although not cut until late in the summer, when the radical leaves of many other grasses are decayed or withered, these continue green, and present no impediment to the scythe. 'In fine, it possesses all the requisites of a good grass—namely, quantity, quality, and earliness.' It yields also abundance of seeds; but they are subject to be destroyed by an insect." One important recommendation of the new valuable species, *Alopecurus nigricans*, is that if it should prove to be subject to the same disease in its seeds as *Alopecurus pratensis*, it can propagate itself independently of them by means of its stoloniferous habit. — *Loudon's Encyclopædia of Plants*.—*Sinclair's Hortus Gramineus Woburnensis*.—*Sproule's Treatise on Agriculture*.—*Treatise on British Husbandry in Library of Useful Knowledge*.—*Journal of the Royal Agricultural Society of England*.—*Catalogue of the Highland Society's Museum*.—*Low's Elements of Practical Agriculture*.

ALPACA, or PACA,—zoologically *Auchenia Alpaca*. A South American quadruped, possessing considerable resemblance to the sheep and the goat, very often regarded as merely a variety of

the sheep, and recently the object of great interest for its sheep-like habits, and especially for its wool, but really belonging to the camel family, and formerly considered by naturalists as an actual species of camel. The whole of the genus *Auchenia* or *Llama*, so far as known, possesses points of considerable interest to the British stock farmer, and at least another species of it, besides the *Alpaca*, presents strong claims for adoption as a domestic animal upon British hill-farms. Hence, were we strictly methodical, we would reserve a notice of all the species for an article on the word LLAMA; but, as the *Alpaca* is the species of greatest interest, and has become popularly known among farmers, and is the medium through which interest in the other species is felt, and forms the topic of much mercantile speculation respecting both the naturalization of the animal and the produce of its wool, we make logic give way to utility, and set up the *Alpaca* as the representative of the whole genus *Auchenia*.

The llama was classed by Linnæus, and other distinguished naturalists of the last century, as a camel; and it was constituted a separate and distinct genus by Illiger, and named *Auchenia* in allusion to the comparatively great length and slenderness of its neck. It differs from the camel in being a much smaller animal, in having no hump on its back, and in wanting the broad elastic pad on the foot, which is so admirably adapted for traversing the arid wastes of the sandy wilderness; but it closely resembles the camel in the general structure and cellular apparatus of the stomach, in the remarkable power of enduring prolonged thirst, in the expression of its large, full, overhung eye, in the division and mobility of its upper lip, in its fissured nostrils, slender neck, and meagre limbs, and in the long, woolly, and finely filamentous character of its clothing. The foot of the llama is directly and most beautifully adapted for climbing craggy, alpine heights, and proceeding with a free and fearless step among the chasms, pinnacles, and rocky wastes of mountain precipices; and, in common with the entire structure and all the instincts and natural habits of the animal, indicates the purpose of the infinitely wise and beneficent Creator, that the llama should enjoy comfort to itself, and minister to the wants of man, amidst rugged and savage uplands of too stern a character, or too lofty an altitude, to be easily traversed, or profitably stocked, by any other description of domesticable animal. Two springy toes, terminating in strong, short hoofs, and provided beneath with rough, elongated cushions, constitute the body of each foot; the toes are completely divided from each other, yet lie mutually close, and assist each other's action; and the hoofs are laterally compressed, pointed at the tip, and hooked over nearly in the form of claws, their upper surface like an acute ridge, and their under surface linearly concave.

The native country of all the species of llama is the most grandly mountainous in the world, the alpine portion of Chili and Peru, the sublime region of the Andes or Cordilleras from the equator to nearly the southern extremity of South America, second in altitude only to the Himalayan mountains of Hindostan, rising in successive ranges tier over tier from the seaboard of the Pacific to altitudes far above the line of perpetual snow, and possessing, between base and summit, an epitome of all the climates and almost all the countries of the globe. Along the seaward base of this stupendous region extends a narrow belt of plain, scorched with the rays of a vertical sun, and almost never refreshed by a fall of rain, yet so invigorated by heavy dews from the clouds, and animated by fertilizing rills from the mountains, as to enjoy a perpetual spring, and luxuriate in the richest vegetation. But along the acclivities, the summits, and the vast terraces of the lower ranges, tropical heats and plants are suddenly succeeded by those of the temperate zone; and after the summits of the middle ranges are attained, the rays of the sun lose their fervour and energy, the air is chilled, and vegetation dwarfed by freezing winds, and the ascents of the land are a series of rocky, barren, icy regions, called by the natives punas, rising ridge above ridge in a struggle for terrific wildness and sterility, and succeeded in the far sky-soaring distance by an upper world of rocky crests and deep ravines, of alpine pinnacles and massive crags, of awful precipices and horrid chasms, which human foot has never trod, and the eagle's wing has scarcely overshadowed. In the zone of these wondrous regions, a little below the line of perpetual snow, and at altitudes of from 8,000 to 12,000 feet above the level of the sea, flocks of the domesticated species of the llama subsist themselves on the wild and scanty herbage, and constitute the chief care and the principal wealth of the mountaineer Indian; and in a still higher zone, at altitudes of from 12,000 to 14,000 feet above the level of the sea, under almost perpetual mist and snow, and in situations chiefly inaccessible to the foot or even the eye of man, live the wild species of the llama, travelling from peak to peak with the facility of the chamois and the swiftness of the gazelle, and seeming to find sustenance and comfort almost from the naked rocks and glittering snows. "Here, amidst broken and precipitous peaks, on the parapets and projecting ledges, slightly covered with earth, or in the valleys formed by the mountain ridges, like the Pyrenean chamois, the llama and alpaca pick up a precarious subsistence from the mosses, lichens, tender shrubs, and grassy plants, which make their appearance as the snow recedes; or, descending lower down, revel in the pajonales, or, as they are called in some parts of the country, ichuales, natural meadows of the ichu plant, the favourite haunts of the tame and wild kinds. Thus the

hand of man never prepares food for either kind, —both readily find it on their native mountains. Besides the extremes of cold, these animals have equally to endure the severities of a damp atmosphere; for while below it seldom rains, in the summer months, when evaporation from the sea is abundant, clouds collect, and being driven over the lower valleys by strong winds from the south and west, and condensed by the cold, burst on the highlands, where the rain falls in torrents, amidst the most awful thunder and lightning."

When the Spaniards first invaded Chili and Peru, they found the llama, not only in a wild state, but also domesticated by the inhabitants; and struck with the similarity of its uses to those of the sheep of Europe, they called it 'the sheep of the country,' and began to employ it in the same manner as the natives. Its flesh was eaten, its skin was made into leather, and its wool was spun and manufactured into cloth. The living animal was also in great request, and of high value as a beast of burden; it carried ore from the mines in the mountains, in loads of from 80 to 100 pounds, at the average speed of twelve or fifteen miles a-day, along difficult tracts, and through the most rugged passes; and when too heavily laden, or when urged to travel beyond its ordinary pace, it lay down, and obstinately refused to proceed. Augustine De Zarata, Spanish treasurer-general of Peru in 1544, committing the common mistake of his countrymen in confounding this remarkable animal with the sheep, says, respecting the llama, "In places where there is no snow, the natives want water, and to supply this they fill the skins of sheep with water, and make other living sheep carry them, for, it must be remarked, these sheep of Peru are large enough to serve as beasts of burden. They can carry about one hundred pounds or more, and the Spaniards used to ride them, and they would go four or five leagues a-day. When they are weary, they lie down upon the ground; and as there are no means of making them get up, either by beating or assisting them, the load must of necessity be taken off. When there is a man on one of them, if the beast is tired, and urged to go on, he turns his head round, and discharges his saliva, which has an unpleasant odour, into the rider's face. These animals are of great use and profit to their masters, for their wool is very good and fine, particularly that of the species called pacas (alpaca), which have very long fleeces; and the expense of their food is trifling, as a handful of maize suffices them, and they can go four or five days without water. Their flesh is as good as that of the fat sheep of Castile. There are now public shambles for the sale of their flesh in all parts of Peru, which was not the case when the Spaniards came first; for when one Indian had killed a sheep, his neighbours came and took what they wanted, and then another Indian killed another sheep in his turn." D'Acosta, one of the earliest naturalists who

visited the new world, and who published his observations in 1790, says, "There is nothing in Peru more useful or more valuable than the country sheep called llamas, and they are as economical as they are profitable. They have a long neck, similar to the camel, and this they require; for being tall and upright, they stand in need of an elongated neck to reach their food. The meat is good: that of the fawn is best and most delicate, although the Indians use it sparingly; their principal object in rearing this breed of cattle being to avail themselves of its wool for clothing, and of its service to carry loads. The wool they were accustomed to weave into garments, one of their kinds of cloth, called huasca, being coarse, and in more general use; while the other, known by the name of cumbi, was of a finer and more delicate quality. Of the latter, they still make mantles, table-covers, quilts, and various articles of ornamental dress, which are durable, and have a gloss upon them, as if partly made of silk. The Indians still possess large droves, consisting of 400 or 1,000 head each, which they load, and with them perform journeys, travelling like a string of mules, and carrying wine, cocoa, chuno, quicksilver, and other articles of merchandise, and more especially that which of all others is the most valuable, namely, silver, ingots of which they bear from Potosi to Arica, a distance of seventy leagues, as they formerly did to Arequipa, more than twice as far. They are accustomed to a cold climate, and thrive best in the highlands. Often does it happen that they are covered with snow and sparkling with icicles, and yet healthy and contented." Inca Garcilasso de la Vega, a native Peruvian, said, at a later period than D'Acosta, "The domestic animals which God was pleased to bestow on the Indians, congenial to their character, and like them in disposition, are so tractable that a child may guide them, more particularly those accustomed to bear burdens. The skin was anciently steeped in tallow, in order to prepare it; after which the Indians used it for shoes, but the leather not being tanned, they were obliged to go barefooted in rainy weather. Of it, the Spaniards now make bridles, girths, and cruppers for saddles. The paca (alpaca) was chiefly valued for its flesh, but more especially for its wool, long, but excellent, of which the natives made cloths, and gave to them beautiful and never-fading colours." Similar accounts are given by De Laet and Captain G. Shelvocke.

The number of known varieties of the llama is five,—the taruga, the domestic llama, the guanaco, the alpaca, and the vicugna. The first and the second of these appear to be varieties of respectively the alpaca and the guanaco; and the third, the fourth, and the fifth, appear to be distinct species. Yet Baron Cuvier and Mr. Bennett pronounce the guanaco and the vicugna to be the only distinct species, and regard the alpaca, the taruga, and the domestic llama as all

varieties of the guanaco, the first being distinguished simply by an ample development of its wool. The alpaca, however, appears to us to possess quite a sufficient breadth of peculiar character to entitle it to the rank of a separate species. The brown llama figured in the Naturalist's Library, and supposed there to be a distinct species, appears to be merely a dark-woolled individual of the domestic llama; and the Chilihueque, which the writer of the article 'Brown Llama' in that work seems to think a different animal from any of the ascertained species of llama, is just the domestic llama as found among the Chilese,—the names Chilihueque, Hanaca, and Guanaco, being merely variations of one another,—and the first of these names being applied by the Chilese to the domestic llama, while the second and the third are applied by most writers to the wild guanaco, or original form to which the domestic llama belonged.

The taruga or taruca is rather obscurely known, and figures principally in the accounts of De Laet. Though seemingly most allied to the alpaca, it possesses the distinctive characters of a solitary or ungregarious habit, and of light and pendulous ears. It is larger, swifter, and of a more burnt colour than the vicugna; and it rarely associates with its fellows, but wanders solitarily about precipices and among wild crags. In the time of the Incas, it was very abundant, and even approached the immediate vicinity of towns. Garcilasso de la Vega mistook it for a species of small deer. Its solitary habit, combined with its similarity in constitution and value to the alpaca, may possibly, at some very early period, instigate a search for it, and recommend its introduction to the most broken and rocky districts of Scotland and Wales, where herbage is too scanty to afford sustenance to flocks.

The domestic llama differs from the guanaco chiefly in such properties as result from long domestication, but is both stouter in the body and shorter in the neck; and it must be understood as the variety principally referred to in all statements respecting the former Peruvians' domestic animals and beasts of burden. How early it became domesticated, is not known; but at the date of the Spanish invasion, it was found performing nearly the same offices to the Peruvians, which the camel still performs to the Arabs. Its neck is very long; its tail is a little raised and curved down; its height at the top of the shoulders is about three feet and a half; its colour is occasionally brown, but usually either white or a mixture of white and brown; and its wool is considerably developed, and, but for the superior quality of that of the alpaca and the vicugna, would be in great request. It feeds chiefly upon mountain herbage, particularly upon a coarse rushy grass called ichu or ycho; and when it can obtain a sufficiency of this food, it is never known to drink; yet it possesses these remarkable habits of sustenance, as well as some

other valuable properties, quite in common with the guanaco, the alpaca, and the vicugna. Its saliva is always abundant and exceedingly offensive; yet though formerly thought to be acrid, has been ascertained to be perfectly innocuous. The animal is, in general, very quiet and quite inoffensive; yet it occasionally yields to rather slight provocation; and when fairly irritated, it energetically strikes with its fore-feet, and inflicts very severe blows. Though still of much economical value in its native land, it has been almost wholly superseded as a beast of burden by the introduction of the horse, the ass, and especially the mule, and has been lessened in its importance for wool and flesh by the introduction of the sheep, the goat, and the ox.

The guanaco is more slender, and has the appearance of more spirit and energy than the domesticated llama; but it soon accustoms itself to captivity. Its wool is finer than that of the domestic llama, but not so long; and its colour is grey in the head and ears, and a rich rufous brown in the body. It lives among the mountains during summer; but descends to the valleys, and is hunted by dogs and men on the approach of winter. "The guanaco," says Mr. Darwin, in the Voyage of the Beagle, "abounds over the whole of the temperate parts of South America, from the wooded islands of Tierra del Fuego, through Patagonia, the hilly parts of La Plata, Chili, even to the Cordillera of Peru. Although preferring an elevated site, it yields in this respect to its near relative, the vicugna; on the plains of Southern Patagonia, we saw them in greater numbers than in any other part. Generally they go in small herds from half-a-dozen to thirty together; but on the banks of the St. Cruz, we saw one herd which must have contained at least five hundred. On the northern shores of the strait of Magellan, they are also very numerous. Generally the guanaco is wild and extremely wary. The sportsman frequently receives the first intimation of their presence by hearing from a distance the peculiar, shrill, neighing note of alarm. If he then looks attentively, he will perhaps see the herd standing in a line on some distant hill. On approaching them, a few more squeals are given, and then off they set at an apparently slow but really quick canter along some narrow beaten tract to a neighbouring hill. On the mountains of Tierra del Fuego, and in other places, I have more than once seen a guanaco, on being approached, not only neigh and squeal, but prance and leap about in the most ridiculous manner, apparently in defiance as a challenge. These animals are very easily domesticated, and I have seen some thus kept near the houses, although at large on their native plains. They are, in this state, very bold, and readily attack a man by striking him from behind with both knees. The wild guanaco, however, have no idea of defence; even a single dog will secure one of these large animals till the huntsman can

come up. In many of their habits, they are like sheep in a flock. Thus, when they see men approaching in different directions on horseback, they soon become bewildered, and know not which way to run. This greatly facilitates the Indian method of hunting, for they are thus easily driven to a central point and encompassed." The flesh of the guanaco, though good, is inferior to that of the domesticated llama.

The alpaca is as large as the guanaco, but proportionately shorter in the limbs; it is less fleet than the guanaco, yet resembles it in general habits; it frequents a higher and colder range of elevation, and is frequently seen with herds of the vicugna; its forehead, instead of being regularly arched to the nose, rises abruptly prominent above the eyes; its colour is occasionally black, but usually a deep fawn; and its wool is long, silky, delicately fine, and disposed in long flakes or tassels. Mr. W. Dawson, at the ninth and tenth meetings of the British Association, held in Birmingham and Glasgow, exhibited native samples of alpaca wool, and manufactured undyed specimens in imitation of silk, as black as jet; and he urged that the animals producing it ought to be propagated in England, Ireland, Scotland, and Wales, and stated that it was eminently adapted by its natural habits to at least the Scottish and the Welsh highlands. The wool of the specimens exhibited was from six to twelve inches in length. Alpaca wool became known to the British manufacturer only about the year 1834; and the quantity of Peruvian wool, principally alpaca, imported into Britain during the six following years was 8,000 bales in 1835, 12,800 in 1836, 17,500 in 1837, 25,765 in 1838, 34,543 in 1839, and 34,224 in 1840. The total consumption of alpaca wool in this country, in the seven years ending December 1843, is estimated by Mr. Walton at 12,000,000 lbs.

The vicugna or vicuna is a smaller animal, and more slender in its proportions, than either the guanaco or the alpaca. Its limbs are thin; its neck is attenuated and curved somewhat like that of the swan; its forehead is broad and prominent, yet not so abrupt as that of the alpaca; its muzzle is narrow; its head is short; its eyes are large; its ears are long; the height of its body at the tip of the shoulder is about two feet and a half; its colour is a pale yellowish white, passing into white on the under parts; and its wool is extremely delicate and soft, resembles the fur of the beaver, is from one inch to three inches in length, and possesses the property of resisting heat, so as to be a most suitable material for the manufacture of caps. The vicugna, except for having no horns, and being rather large, might very readily be mistaken for a goat; it lives in herds, and has great swiftness of foot; it is invigorated, rather than annoyed, by frost and snow; it closely resembles the chamois of the European alps in agility, vigilance, wildness, and timidity; and it frequents the most rocky and

precipitous retreats, on bleak and elevated ranges of the mountains, close on the region of perpetual snow. It occurs in Chili, but is found principally in the Cordilleras of Copiapo, Coquimbo, and Peru; it was, at one time, very numerous, but has now become much more rare. For the sake of its wool alone, thousands of individuals of it are annually killed by every method of ensnarement and assault. We have given a very accurate representation of this species in *Plate IV. Fig. 1.*

All the species and varieties of the llama, but particularly the alpaca and the vicugna, hold so conspicuous and valuable a place among wool-bearing animals, that one might have expected them to be introduced to Europe, and domesticated upon the mountains of Spain, Italy, Switzerland, Germany, and Great Britain, with all possible speed after the conquest of America. Europeans found some domesticated, and the others domesticable, throughout Chili and Peru; they observed and admired their rich combination of useful properties, and their remarkable adaptation to new and difficult situations; they saw their wool to be singularly fine and silky, and to be easily convertible into woven fabrics by even the clumsy manipulations of the Indians; and yet, with a surpassing indifference which excites our highest astonishment, neither they nor their successors of eight generations seem to have formed a thought of introducing the hardy and rich wool-bearing race to the countries of Europe. Now, however—though in a very inferior degree to what the interests of stock farmers, of fabric-manufacturers, and of the whole community demand—attention to the llama genus as a suitable line for very upland districts, has been generally excited throughout Great Britain. "Mr. Bennet of Faringdon," says Mr. Walton, in his Memoir of the year 1841, "had a pair of llamas sent to him from Peru, twenty years ago, and fed them as sheep are usually fed, with hay and turnips, in the winter. From his own experience, he found that they are particularly hardy and very long lived. He increased his stock, and has actually had six females at a time which have had young ones. Of these, very few have died. The number of Peruvian sheep in the kingdom at present (July 1841) may be estimated thus;—the Earl of Derby, Knowsley Hall, Lancashire, sixteen; the Marquis of Breadalbane, one; the Duke of Montrose, three; Earl Fitzwilliam, one; Zoological Gardens, Phoenix Park, Dublin, six; Zoological Gardens, Regent's Park, two; J. J. Hegan, Esq., Harrow-Hall, Cheshire, seven; Charles Tayleure, Esq., Parkfield, near Liverpool, five; John Edwards, Esq., Pye-Nest, Halifax, six; Mr. Stephenson, Oban, six; William Bennett, Esq., twelve; Mr. Cross, Surrey Zoological Gardens, one; Mr. Atkins, Zoological Gardens, Liverpool, three; and in travelling caravans, four;—total, seventy-nine. Lately six more arrived in Liverpool. The existence of this number among us, supported by their healthy

appearance, as reported to me from every quarter where I have been able to institute inquiries, is a better proof of the capacity of Andes sheep to adapt themselves to our climate than any further arguments or elucidations which I could adduce." The animals, too, would obviously thrive far better when enjoying liberty on the mountains, than when imprisoned in caravans, in zoological gardens, and in gentlemen's parks; they could sustain themselves on the coarsest herbage, such as the ycho of their native cordilleras; they would, in not a few situations in Great Britain, live and prosper where sheep would famish and die; they most probably would escape all the accidents from snow-storms, and most of the attacks from disease to which our sheep are liable; and, from the singular richness of their wool, and the smartly increasing demand for it which follows the introduction of fair specimens to the market, they would not improbably, on even lowland farms or on costly pastures, yield a more profitable return than sheep. See article WOOL.—*The Pictorial Museum of Animated Nature*.—*The Naturalist's Library*.—*Voyage of the Beagle*.—*Mr. W. Walton's Memoir on Peruvian Sheep as quoted in Johnson's Farmer's Encyclopædia*.—*Portraits and Specimens in the Highland Society's Museum*.

ALPINE-BROOK,—botanically *Saxifraga Rivularis*. A small, evergreen herbaceous plant, of the same genus as the universally known *None-so-pretty*. It grows wild on some of the loftiest of the Scottish mountains.

ALSINE,—popularly CHICKWEED. A genus of annual weeds of the clove tribe. They grow about a foot high, and flower in July. Three species are known in Britain, and three are unknown; and one of the former is a native of British fields, the second is a native of France, and the third is a native of the south of Europe.

ALSTRÆMERIA. A genus of superb South American plants of the amaryllis tribe. Five species are cultivated in Great Britain; and nine other known species have not been introduced. Three of our species are ornamental, bulbous, greenhouse plants; one—the striped-flowered, *Alstræmeria ligtu*—produces useful fruit, and is as fragrant as mignonette; and one—the edible-rooted, *Alstræmeria salsilla* or *ovata*—is a twining plant, cultivated in Peru and the West Indies for its eatable roots, and recently recommended to the attention of British farmers for the similarity of its produce to potatoes.

ALTERATIVES. Medicines designed to effect a slow salutary change in a diseased condition of horses or cattle, without interfering with their food or work, or exciting any sensible evacuation. But by conventional usage, alteratives have come to mean only such medicines as are designed to remove diseases of the skin, the digestive organs, or the circulation; and, in a shamefully large proportion of instances in actual practice, they mean drugs of all sorts which are prescribed by empiricism or administered by well-meaning but

culpable ignorance. Alteratives appear to have become a sanction for all sorts of slow-dosing and general physicking, and ought either to be rigidly defined or totally abolished. Common sense requires that when an animal is unwell, the precise disease under which it suffers should be ascertained, and a precise and expeditious remedy applied. If the illness of a horse be a disease of the skin, let nitre, sulphur, and black antimony be used; if there be any tendency to grease, let some resin be added to each ball; and if there be accompanying weakness, let a little gentian and ginger be added; but, be the case what it may, let not the delusion of alterative treatment be permitted to prescribe the use of any form of mercury, or of any of the heating spices, the mineral acids, or the mineral tonics.—If a cow is unwell, let her be bled or physicked according to the exact nature of her disease, but let not her digestion be nauseated or her constitution ruined by a constant dosing with various drugs. "To a cow with yellows or mange," says Mr. Youatt, "or that cannot be made to acquire condition, or where the milk is diminishing, small quantities of medicine are often administered under the tempting but deceptive term of alteratives. They had much better be let alone in the majority of cases. The want of condition and thriving in cattle is far more connected with a diseased state of their complicated stomachs, and particularly with obstruction in their manyplies, than with any other cause; the alteratives then should be small quantities of purgatives with aromatics, as epsom salt or sulphur with ginger, or, what would be still preferable, rock salt in the manger for them to lick, or common salt mingled with their food. There can, however, be no doubt that, in many cutaneous affections, and especially where mange is suspected, alterative medicines will be very beneficial. They should be composed of Æthiop's mineral, nitre, and sulphur, in the proportion of one, two, and four, and in daily doses of from half-an-ounce to an ounce."

ALTERNATE HUSBANDRY. The system of farm management which alternates land between grass and tillage; so as to have part of a farm in sward, and part clear of all herbage except the tillage crop. This system changes any field or series of fields from grass to tillage, or from tillage to grass, as the nature of the land or the comparative profits of grazing and tillage husbandry require; and, in many situations, it is more remunerating, less laborious, and keeps lands freer from weeds, and from the risk of manurial exhaustion, than the system of a constant rotation of tillage crops or of mere occasional summer fallowing. See articles HUSBANDRY, ROTATION, and GRASSES.

ALTHÆA. See MARSHMALLOW and HOLLY-HOCK.

ALTHÆA FRUTEX or SYRIAN MALLOW,—botanically *Hibiscus Syriacus*. A hardy shrub of the Hibiscus kind, and Mallow family. It is a

native of Syria, but flowers freely in almost any common garden ground in England, and is one of the most beautiful of our ornamental shrubs. The well-defined and thoroughly-established varieties of it are six,—the purple-flowered, the red-flowered, the white-flowered, the striped-flowered, the double white, and the double purple, and all attain a height of eight feet, and bloom in August and September. Their branches are smooth, whitish, and not very numerous; their leaves are ovate-spear-shaped, serrated, of a pleasant green, and growing on short irregularly-situated footstalks; and their flowers have longer footstalks than the leaves, and come out with them from the sides of the young shoots in such a manner as often to garnish the young shoots over their whole length. The *Althæa frutex* is easily propagated from either seeds, layers, or cuttings.

ALTITUDE or ELEVATION. The height of land above the level of the sea. This is an important element in all just calculations respecting vegetable physiology, the making of plantations, and the rotation of crops. Vegetation, in ascending above the level of the sea, undergoes modifications analogous to those which attend its progress from the equator to either pole. Thus 600 feet of altitude above sea-level is found to be equal, in its influence upon both indigenous and cultivated vegetation, to a removal of one degree from the equator, or between 60 and 70 miles toward the north or south; so that a situation only a few feet above sea-level in the latitude of Edinburgh is equal, in its genial powers, to a situation about 3,000 feet above sea-level in the latitude of London, and the height of 4,000 or 5,000 yards in the hottest parts of the globe produces changes as distinct as the 2,000 leagues or more which lie between the equator and the polar regions. Other elements than mere altitude, indeed, contribute to the aggregate character of climate,—particularly the direction of slope or exposure, the angle of elevation, the lowness or mountainousness of surrounding country, nearness or distance from the saline vapours of the ocean, favourableness or unfavourableness of surrounding surface for natural ventilation, the direction, force, and temperature of the prevailing winds, the amount and modifications of atmospheric moisture, the mineral constitution and mechanical condition of both the immediate and the surrounding soil, and the general prevalence of marshiness or aridity, of natural forests or cultivated fields, of pastoral grounds or arable farms; and so greatly do these elements and some others modify temperature, that *isothermal lines*, or lines of equal heat as drawn by observation around the globe, are found to make very surprising curvatures, and to vary, in numerous instances, to the enormous extent of eight or ten geographical degrees [see article CLIMATE]; yet altitude alone is so great an element, and exerts of itself so powerful an influence, that, in any one country or series of contiguous countries of

tolerably uniform character in soil and cultivation, it may fairly be regarded as the equivalent of climate, in the proportion of 600 feet of altitude to one degree of latitude. The reason of this is, that altitude involves diminution of heat, dryness of air, protracted duration of light, a decrease of depth in the volume of the air, and a scarcity of those substances which are produced by the decomposition of organic bodies.

The higher we ascend, the shallower the upper stratum of air becomes; whence the excessive cold at great heights; for it is the action of the atmosphere upon the rays of light which extracts the caloric from them, and we know that the extraction of caloric diminishes in proportion as the mass of air traversed by the rays is shallower; but, on the other hand, the light is purer and more active, just as if caloric was really a simple transmutation of light, as some naturalists have conceived it to be. The weight of the atmosphere, which at the level of the sea supports a column of mercury 28 inches high, diminishes as we ascend; so that at the elevation of 6,000 yards it will only support a column of 13 inches and some lines high. A consequence of this fact is, that the vaporization of fluids takes place on high mountains at a very low degree of heat. Notwithstanding this, however, the decrease of heat is so great, that the ambient air is very slightly impregnated with moisture. It is true that heights have not the long days of the polar regions; but they receive the rays of the sun earlier than the plains, and are quitted later by them, so that their nights are shorter than in levels. In fine, substances which have been formed by the decay of organized bodies, are rare on mountains, the rains as well as the waters of the springs dissolving them, and carrying them away as they run off into the valleys. It cannot be doubted, but these causes united must act powerfully upon vegetation. The slightest degree of heat will cause the plants on mountains to transpire copiously; the severity of the cold, the dryness of the atmosphere, the shortness of the nights, the scarcity of humus, will impede the enlargement of their leaves, and the growth of their stems; the strength of the light, and the protracted duration of the day, will accelerate the induration of all the parts of their frame.

The course of vegetation on mountains had not escaped the penetration of Tournefort. At the foot of Mount Ararat he had observed the plants which grow in Armenia; a little higher, those of Italy and France; above, those of Sweden; and upon the summits, those of Lapland. Observations of the same kind had been subsequently made on Mount Caucasus, the Alps, the Pyrenees, and other mountains of the Old continent. Every botanist had learned that many of the alpine plants, that is to say, plants which grow on the various high lands of Europe and Asia, are likewise met with at Spitsbergen, in Nova Zembla, Lapland, and Kamschatka. Swartz had discov-

ered on the mountains of Jamaica, under a still hotter sky, if not plants exactly of the same species with those of our alpine phænogamous ones, at least some that were analogous to them; and a great many of the cryptogamous species precisely the same as our own: For example, *Funaria hygrometrica*, *Bryum serpyllifolium* and *cespititium*, *Sphagnum palustre*, *Dicranum glaucum*, &c. Linnæus, in his own way, had summed up these facts in an axiom. "The different kinds of plants," says he, "show by their stations the perpendicular height of the earth." Yet it was not till lately that any exact survey had been taken of this interesting department of botanical geography. The first connected series of researches made with the direct intention of ascertaining the progressive succession of plants on mountains, was instituted by M. Ramond. That celebrated individual devoted ten years to the investigation of the entire chain of the Pyrenean mountains; and studied it not only as a geometer, natural philosopher, and mineralogist, but also as one of the most skilful of botanists; he discovered the stations to which the different species of vegetables belong, and the special circumstances which sometimes cause a derangement in the natural order of their succession. We shall here shortly point out some of the results of his observations. The Common oak (*Quercus robur*) grows in the plains, on a level with the sea; reaches the slopes of the mountains, and ascends to the height of 1,600 yards. It degenerates in proportion as it approaches the point where it ceases to vegetate. The beech (*Fagus sylvatica*) makes its first appearance at the height of 600 yards above the sea, and its last 200 yards above the oak. The silver-fir (*Picea pectinata*), and the yew (*Taxus communis*), show themselves at 1,400 yards, and go on to about 2,000. The Scotch-fir (*Pinus sylvestris*), and mugho pine (*Pinus pumilio*), take their stations between the heights of 2,000 and 2,400 yards. There the trees stop, and shrubs, with a juiceless foliage, and low or creeping stems, present themselves; these lie hid beneath the snow in the winter. Among them are some of the Rhododendrons, Daphnes, Passerinas, the *Globularia repens*, the two species of *Salix*, *herbacea*, *reticulata*, &c. Soon after we meet only small herbs with perennial roots, spreading radical leaves, and a naked stalk. These, with the Lichens and Byssi, arrive at the height of 3,000, and even 3,400 yards. The first that occur are the *Gentiana campestris*, *Primula villosa*, *Saxifraga longifolia*, and *Aizoon*, &c.; then *Ranunculus alpestris*, *nivalis*, *parnassifolius*, *Arctia alpina*, and finally, *Ranunculus glacialis*, *Saxifraga cæspitosa*, *oppositifolia*, *Androsæcea*, and *Groenlandica*. The last brings us to the borders of eternal snow.

Botanists who have explored the Alps, have remarked phenomena perfectly corresponding with those observed by M. Ramond in the Pyrenees. But it was reserved for Messrs. Humboldt and

Bonpland to demonstrate the succession of modifications in the vegetable structure on the highest mountains yet known, and in one of the hottest and most fertile regions of our globe. Baron Humboldt made similar observations, as to successive zones of vegetation, in his personal ascent of Teneriffe. The first zone, extending from the coast to a height of from 400 to 500 yards, is a region of vines, well cultivated, and producing vines, olives, wheat, plantains, and date-trees; the second, extending from the preceding to a height of about 1,800 yards, is a region of laurels, producing a sward of mosses and grasses, and many plants with showy flowers; the third, extending from the second to a height of about 2,770 yards, is a region of pines; the fourth is a region of brooms, of nine or ten feet in height, and affording sustenance to wild goats; the fifth is a zone of mere alpine grasses and cryptogamic plants, scantily covering heaps of lava; and the sixth is a region of absolute sterility, producing not even mosses or lichens. The great power which mere altitude exerts over climate and vegetation explains the interesting facts, that regions have usually a poor or a rich flora in the degree of their own diversity of surface,—that the plants of two countries within the same parallels of latitude, the one a mountainous and the other a champaign country, constitute totally different groups,—and that the plants of even the same country and the same latitude, as those of the north-west and the north-east coasts of America, or as those of the south-east and the south-west coasts, are sometimes very widely dissimilar. "In the equinoctial countries of America," says M. Brisseau Mirbel, "vegetation displays itself to the view of the observer as on the gradually rising steps of an immense amphitheatre, the base of which sinks below the waters of the ocean, while its summit reaches to the foot of the glaciers which crown the Andes, 5,000 yards above the level of the sea; showing that in America there are vegetables which grow at the height of 1,600 or 1,800 yards beyond the point where vegetation ceases in the Pyrenees and Alps; a difference that does not depend solely upon latitude, but likewise, according to M. Ramond, upon the breadth, or, if you will, the thickness of the chain of mountains. In chains of but little breadth, such as those of Europe, the air and temperature of the plains have an influence, which is constantly tending to confound the limits of the different kinds of vegetables; but this is not the case in the chain of the Andes, which is from 48 to 60 leagues in breadth. Messieurs Humboldt and Bonpland have had also this advantage in their researches, that as these were made under the equator, they have been enabled to trace the whole series of modifications which are to be met with between the two extremes of temperature found at the surface of the globe; while other botanists, having explored none but the northern mountains of the Old continent, could only trace

the modifications between a mean temperature and extreme cold. The plants which belong to dark and humid abodes, such *Boletus ceratophorus*, and *botrytes*, *Lichen verticillatus*, *Gymnoderma sinuata*, and *Byssus speciosa*, are found on the vaults of caverns and the woodwork of mines, as well in Mexico as in Germany, England, and Italy. Concealed within the bowels of the earth, these less perfect species constitute the last zone of vegetation. Next come the plants which belong to fresh-water and salt-water. Of these, a great portion grow without preference in every degree of latitude; the medium in which they exist preserving a more equable temperature than the atmosphere. Duck-weed (*Lemna minor*), and the Greater reed-mace or cat's-tail (*Typha latifolia*), grow in the marshes both of Asia, Europe, and America. The *Typha latifolia* belongs in common to Jamaica, China, and Bengal. Probably there is no region on the globe where the gray bog-moss (*Sphagnum palustre*) is not to be found. This indifference to climate is still more remarkable in the sea-plants, such as the Fuci, Lavers, and Ceramias. The gulf-weed (*Fucus natans*), detaching itself from the rocks on which it grew, and forming shoals of an immense extent at the surface of the water, obstructs the way of the ships as well towards the poles as under the line. On a level with the sea to the height of 1,000 yards, we find the palms, the liliaceous plants, the plantain trees, the Scitamineæ, the genera *Theophrasta*, *Mussaenda*, *Plumeria*, *Cæsalpinia*, *Hymenæa*, the *Cecropia peltata*, the balsam of Tolu, the cusparé or cinchona of Carony, with crowds of other species which grow only in a very hot temperature. This is the zone of the palms; a tribe conspicuous for the elegance and grandeur of part of its species, and forming one of the chief ornaments of the scorching plains that lie between the tropics. Some of them thrive, however, in more temperate regions. The *Ceroxylan andicola*, a fine palm, rising 60 yards in height, grows in the Andes at Tolima and Quindiu, in the 4° 25' of northern latitude, setting off at 1,800 yards above the sea, and continuing to the height of 2,870, an elevation where the atmosphere is at a moderate degree of warmth. Another species has been discovered at the straits of Magellan, towards the 53° of southern latitude. Two sorts, the fan-palm (*Chamærops humilis*) and date-tree, are even seen to grow on our side of Europe, upon the coasts of the Mediterranean, and not far from the foot of the Pyrenees, thus advancing their tribe to beneath the 43d degree of northern latitude. But these are the exceptions; the palms in general confining themselves to the hottest parts of the globe, and none being met with towards the polar regions. The zone of the arborescent Ferns and the Cinchonas succeeds to that of the Palms and Scitamineæ. The ferns begin at 400 yards, and end at 1,600. The cinchonas grow to about 2,900 yards high. The oaks begin to appear at 1,700 yards. These are

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deciduous, and by their periodical evolutions from the bud, remind the European, while wandering in these distant regions, of the mild springs of his native land. Trees cease to grow at the elevation of 3,500 yards, where the shrubs, which before had formed but a small part of the vegetation, take their place, and cover the whole soil. A good deal lower, at about 2,000 yards, the Gentians, Lobelias, Crowfoots, or Ranunculuses, &c., which answer to our Alpine plants, have already begun to show themselves, and keep on from thence to 4,100 yards. At this point, where snow occasionally falls, the grasses, whose numerous species were mingled in the vegetation of the lower steps of the amphitheatre, begin to reign alone. The oat-grasses (*Avena*), bent-grasses (*Agrostis*), cock's-foot-grasses (*Dactylis*), panic-grasses (*Panicum*), feather-grasses (*Stipa*), *Jarava*, &c., here cover the face of the mountains, and continue their career up to 4,600 yards, the point at which phænogamous vegetation ceases."

Any considerable altitude of the site of an intended plantation above sea-level, will so greatly influence vegetation, even in spite of the utmost possible suitableness of soil and culture, as to render the rejection of the less hardy kinds of trees indispensable. The birch genus and some of the pine or fir tribe were found by Humboldt to grow at higher altitudes than any other kind of trees. In latitude 20°, the pine grows at altitudes of from 12,000 to 15,000 feet above sea-level, while oak has not been observed at an altitude of more than 10,300. The hooked pine, *Pinus uncinatus*, the red spruce fir, *Abies rubra*, and the common birch, *Betula alba*, occur at higher altitudes than any other trees, and nearest to the limits of perpetual snow, on Mount Caucasus and on the Pyrenees; but in latitudes 45° and 46° upon the Alps, the common spruce is not found at a higher altitude than about 5,900 feet,—and in latitudes 67° and 70° in Lapland, the birch is found at the altitude of 1,600 feet. The influence of different altitudes on the distribution and growth of forest trees, is evident even in the woodlands of Great Britain. The pine, the fir, and the birch occupy regions of even British uplands which are not inhabitable by other trees; the sycamore and the mountain ash grow in a zone below the regions of pines; and the oak, the beech, the poplar, the ash, and the chestnut, grow on hilly grounds lower than the zone of the sycamore, and higher than can be inhabited by numerous acclimated exotic trees. When, therefore, the ground intended for a plantation is so high in England or so far north in Scotland as to belong to the alpine zone of climate, the only species of plants selected for it ought to be the Scotch fir, the Norway spruce, the larch, the hooked pine, the common birch, the sycamore, and the mountain ash.

Any considerable altitude in the position of a farm, not alone affects it with a lower temperature, a greater moisture, and stronger winds than

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if it were situated in a low plain or valley, but entails upon it a number of both consequent and accompanying disadvantages. Its grass lands yield a less succulent and nourishing herbage, and are slower in reproduction; its cereal crops bear less plump grain, run more to straw, and are longer in ripening and more liable to accidents; its soils are more seriously washed away by heavy rains, and more deprived of their finest particles after every process of tilling and pulverization; its facilities for obtaining extraneous manures are much fewer, and its obstacles to every description of horse labour more numerous and stubborn; its lands are colder, more denuded of argillaceous and calcareous powders, more gritty, gravelly, and churlish, and less fitted, in both mineralogical and mechanical condition, for producing wheat or the other valuable grains; and its whole economy is less compact within, less independent of exterior aids, and less freely connected with surrounding farms and the neighbouring markets. But the directly climatic influence of altitude upon a farm is comparatively great. In latitudes 54° and 55° in Great Britain, an altitude of 500 feet above sea-level is the highest at which wheat can be cultivated with any probability of profit; and even there, the grain is liable to be very light, and will frequently be a month later in ripening than such as grows on the neighbouring plains. In the same latitudes, an altitude of from 600 to 800 feet, according to the exposure, the nature of the soil, and other modifying circumstances, is the highest at which barley and oats can be profitably cultivated; and in backward seasons, crops grown at these altitudes will be of small value, and will sometimes yield nothing but straw. Yet in the loftiest hills and second-rate mountains of the county of Wicklow in Ireland, rye has long been successfully cultivated on lands and in positions where barley and oats would be entire failures.

On farms in high and humid situations in the lowlands of Scotland, or in the practicable parts of the Scottish highlands, the principal objects of husbandry ought to be good grass for pasture, and the securing of an ample supply of winter food for live stock; and the attainment of these objects ought to be sought by the improvement of grass lands, the wise management of hay-meadows, the cultivation of lands fit for producing turnips and other green crops for cattle, the growing of potatoes for the use of man, and the incidental production of grain crops in the ordinary steps of rotation necessary for the most regular, permanent, and profitable supply of grass, hay, and turnips. See GRASS, LANDS, PASTURES, FARMS, WASTES, DRAINING, IRRIGATION, and other articles. In all such situations tillage is advisable only in so far as it conduces to the production of turnips and hay, and the permanent improvement of the soil for pasture; and the crops of grain, which necessarily form parts of the rotation, can never be depended on for profit, ex-

cept as yielding straw for the feeding and littering of cattle, and for the preparation of suitable manure for turnips. The most suitable rotation is, first, oats from old ley; next, turnips, and the necessary proportion of potatoes, with the whole of the manure produced on the farm; next, early oats or barley, sown with grass and clover seeds; next, hay; and then a continuation of the grass into pasture during at least three years, and during as much longer a period as will comport with a due extent of the farm being under tillage for the raising of turnips and the full consumption of manure.—*Keith's Botanical Lexicon*.—*Humboldt's Travels*.—*Dr. Prout's Bridgewater Treatise*.—*M. C. F. B. Mirbel's General Views of Vegetable Nature*.—*Treatise on Planting in Library of Useful Knowledge*.—*Sir John Sinclair's Code of Agriculture*.—*Sir John Sinclair's General Report of Scotland*.

ALUM. A double salt, consisting of the sulphate of potash and the sulphate of alumina. It is a white coloured, translucent salt, crystallizes in regular octahedrons, has a powerfully astringent and somewhat acid taste, is usually sold in large crystalline masses, and makes a considerable figure in the veterinary surgeon's collection of drugs. According to the analysis of Berzelius, it consists of 34.23 of sulphuric acid, 10.86 of alumina, 9.81 of potash, and 45.00 of water. It dissolves in from 15 to 18 times its weight of cold water, and in less than its own weight of boiling water. It is found native, as an efflorescence from certain rocks and soils, and is made from various aluminous minerals. It is manufactured in very large quantities at Whitby in Yorkshire, and Hurler in the vicinity of Paisley. Alum is a most important salt for the arts, especially in dyeing and colour-printing, forming the chief basis for light and bright colours. In medicine, it is a powerful astringent, and as such is used both internally and externally. In a state of fine powder, it is sometimes externally applied, in veterinary practice, for stopping bleeding and destroying small excrescences, and sometimes blown through a quill into the eye for the removal of specks of long continuance. A mixture of alum, in doses of two drachms, with other astringents, is sometimes administered internally in cases of diarrhoea, diabetes, and hæmorrhage; but, always in this form, and often in any form whatever, it is far more likely to be mischievous than beneficial. Alum lotion, made by dissolving from six to eight drachms of alum powder in two pints of water, is a frequent and tolerably efficacious application for superficial sores, cracked heels, and mild forms of grease, but ought not to be used till the surrounding inflammation has been subdued; and, in its weakest state, it is often employed for the cure of wounds or ulcers in the mouth of animals, and of canker in the ear of dogs. A solution of alum, double the strength of this lotion, and rendered increasingly powerful by the addition of a small quantity of white vitriol,

is much more serviceable for grease and cracked heels in horses; and is also a good remedy for such kinds of swellings in the legs as are attended with exudation of moisture. Some practitioners ignorantly and absurdly add Goulard's lotion to this solution; and in consequence effect a chemical decomposition, which transmutes the whole astringent contents of the liquid into alumina which possesses very little astringency, and the sulphates of lead and potash which possess no astringency whatever. Alum ointment—which is made by melting together one drachm of powdered alum, one ounce of turpentine, and one ounce of hog's lard—is occasionally employed as a substitute for the lotion when the sores are liable to become hard and dry; yet it is of such trifling importance as not to be noticed by some of the best masters in veterinary surgery. Alum whey, made by dissolving two drachms of the powder in a pint of hot milk, is often administered to the horse in cases of diarrhoea; and though it may sometimes succeed when other remedies fail, it is by no means so good an astringent as catechu or kino. This remedy, however—especially if a drachm of ginger be added in every case, and also a scruple of opium in a case of very violent purging—is eminently suitable for diarrhoea in the cow. If alum be mixed with any vegetable astringent, the peculiar power or astringency of both is diminished. Burnt alum—prepared by burning a piece of alum on an iron plate till it becomes quite dry and opaquely white—is greatly milder than the alum itself, and therefore may be a less objectionable remedy for specks in the eye, but possesses too little causticity to be a proper application for wounds.—*Ure's Dictionary of Chemistry.*—*Anderson's Commercial Dictionary.*—*White's Farriery.*—*Clater's Cattle Doctor.*

ALUM SLATE. A bluish, argillaceous, schistose rock, found in most of the hills between Scarborough and the river Tees, and in a considerable portion of the mountains of Scotland and Ireland. It splits like the Cornish slate; and it yields, by disintegration, a clayey soil. It contains, in considerable proportions, sulphur, iron, and alumina, and is the substance from which alum is chiefly prepared artificially. The broken stone is calcined in heaps, in a furnace like a limekiln, or in a reverberatory. It is then exposed to effloresce, and daily moistened with water for several months. The mass gradually sinks, and is converted into a paste, above which is a liquid containing a basic alum. This is heated for several hours in copper or lead vessels, and when cooled and settled, the clear liquor is drawn off into crystallizers. A soft variety of it closely resembles clay-slate in appearance, but, by exposure to the air, it forms a saline efflorescence, greatly increases in thickness, breaks up into exfoliations or scales, and speedily undergoes complete disintegration. Alum slate occurs both in rocky masses and in insulated balls. Some varieties of

clay slate are often confounded with alum slate. See CLAY SLATE.

ALUMINA. The pure earth or characteristic matter of clay. It was called alumina in consequence of having been obtained in a state of the greatest purity from alum, by the chemical abstraction of the potash and the sulphuric acid with which it is there combined. The oriental gems, ruby and sapphire, afford specimens of the purest native alumina, for they consist solely of this earth, and a small portion of colouring matter. When quite or nearly pure, alumina has no smell, little taste, and little astringency; and would not be suspected by a sciolist to have any relation to either alum or clay. It is exactly twice the weight of water; and when heated, it parts with a portion of water, and contracts in bulk. Its strong affinity for water under low temperatures, and the readiness with which it gives off water under heat, account for the constant wetness and plashiness of clay soils during winter, and for their contractions, crackings, hardness, and aridity, after a period of drought in summer. Clay always contains a large proportion of other substances than alumina, some in a state of chemical combination with it, and some in a state of mechanical mixture or accompaniment; and the earthy smell which it emits when breathed upon, is occasioned by the presence of oxide of iron. See CLAY. Sir Humphrey Davy, though he did not succeed in obtaining from alumina a metallic base in a separate state, conducted experiments which quite or nearly demonstrated that alumina is the oxide of a metal which has since been termed aluminum.

Alumina exists, in a greater or less proportion, in all cultivated soils; yet it exerts an influence on vegetation, chiefly by attracting and retaining water and ammonia, and is very rarely found, as a separate earth, in the ashes of plants. One three-fifths of a grain of alumina are found in thirty-two ounces of the grain of wheat, and about four grains in thirty ounces of the grain of barley or oats. But it constitutes 3·72 parts in 100 of the entire plant of the sunflower, 7·11 of the entire plant of Turkey wheat, and 14 of the entire plant of the fumitory. Its principal existence and operation in the economy of soils and vegetation is in the form of SILICATE, SULPHATE, and PHOSPHATE: see these articles. The chief aluminous minerals, whose disintegration yields alumina to soil, and contributes argillaceous or clayey earths to arable land, are potash and soda felspars, Labrador spar, mica, and the zeolites; and these minerals occur in mechanical mixture with other substances in granite, gneiss, mica-slate, porphyry, clay-slate, greywacke, clinkstone, basalt, greenstone, mountain limestone, transition limestone, dolomite, muschel kalk, and various sandstones,—rocks which constitute probably nine-tenths of all the hills and mountains of the three kingdoms, and a very large proportion of the immediate substrata of plains and

valleys. See articles GRANITE, MICA, TRAP, PORPHYRY, BASALT, LIMESTONE, SANDSTONE, and GREYWACKE. Aluminous minerals, so essential to the fertility of soils, are the most extensively and minutely diffused on the surface of the earth; and they can occasionally be absent from soils capable of cultivation, only when certain of their constituents are supplied from other sources. Aluminous or argillaceous earths, therefore, must be pronounced essential to the productiveness of soil; and they owe all their value to their invariably containing alkalies and alkaline salts, with sulphates and phosphates. "In order," says Dr. Liebig, "to form a distinct conception of the quantities of alkalies in aluminous minerals, it must be remembered that felspar contains 17½ per cent. of potash, albite 11.43 per cent. of soda, and mica from 3 to 5 per cent., and that zeolite contains from 13 to 16 per cent. of alkalies. The late analyses of Ch. Gmelin, Lowe, Fricke, Meyer, and Redtenbacher, have also shown that basalt and clinkstone contain from ¾ to 3 per cent. of potash, and from 5 to 7 per cent. of soda; that claystone contains from 2.75 to 3.31 per cent. of potash, and loam from 1½ to 4 per cent. of potash." See ALKALIES, POTASH, SODA, and ARGILLACEOUS SOILS.—*Sir Humphrey Davy's Agricultural Chemistry*.—*Liebig's Chemistry of Agriculture*.—*Johnstone's Lectures on Agricultural Chemistry*.—*Ure's Dictionary of Chemistry*.

ALVEOLI. The sockets in the jaw of an animal in which the teeth are set. The spongy parts around these sockets are called the *alveolar processes*. Alveoli, in the original sense, are the cells in a honeycomb; and the teeth sockets in the jaw are called alveoli from their fancied resemblance to these cells.

AMARANTH, or **FLOWER-GENTLE**,—botanically *Amaranthus*. A large genus of annual flowering plants, forming the type of the order *Amaranthaceæ*. This order comprises the genera *Achyranthes*, *Philoxerus*, *Desmochætæ*, *Alternanthera*, *Ærua*, *Lestibudesia*, *Deeringia*, *Celosia*, *Gomphrena*, *Aphananthe*, *Amaranthus*, and *Iresine*. The leaves of most of the plants of the order, especially when young, are of a lax, soft texture, and abound in saccharine, mucilaginous, and fibrous particles, and are therefore fit for food; and the seeds of most are farinaceous, consisting of starch and mucus, and are nutritive, emollient, and demulcent. They are found in both hemispheres, and in most countries of the world; yet they are rare near the equator, and increase both northward and southward in receding into the temperate zones. Greatly the majority are weeds; yet the genus *Gomphrena*, the genus *Celosia*, and some species of *Amaranthus* are highly ornamental. The number of species of *Amaranthus* growing in Great Britain is about forty; and the total number known is nearly fifty. All the species in Great Britain are annuals: all, with one exception, are hardy; most are from the East Indies, a few are from continental Europe, the Levant,

North America, Brazil, China, and Japan, and one—*Amaranthus blitum*—is indigenous on the dunghills of England. Two—*Amaranthus hypochondriacus* and *Amaranthus caudatus*, often called the lesser and the greater amaranths, and very popularly known under the names of prince's feather and love-lies-bleeding—are cultivated as favourite border flowers throughout Britain; three others—*melancholicus*, *tricolor*, and *sanguineus*—are cultivated in Britain as ornamental annuals; one—*polygamus*—is cultivated as spinage in Guiana and China; and three—*oleraceus*, *tristis*, and *viridis*—are used as spinage in the East Indies.

AMARYLLIS. A large genus of gorgeous bulbous plants, constituting the type of the natural order amaryllidæ, but often identified, by popular designation, with the lily tribe. The order amaryllidæ comprises the genera *narcissus*, *pancratium*, *eucrosia*, *eurycles*, *calostemma*, *chlidanthus*, *chrysiphiala*, *hæmanthus*, *galanthus*, *leucogium*, *strumaria*, *crinum*, *cyrtanthus*, *brunsvigia*, *nerine*, *amaryllis*, *vallota*, *griffinia*, *sternbergia*, *zephyranthes*, *habranthus*, *doryanthes*, *gethyllis*, *alstroemeria*, and *conanthera*. This great group of plants is so superb in the form, tints, and fragrance of its flowers as to have been in high popular favour since at least the days of Solomon, and to figure in the most glorious of all records as "the lilies of the field." All have bulbous roots; all, excepting *doryanthes* and some species of *crinum*, are less than two feet in height; they possess a singular uniformity of foliage; they vary in the colour of their flowers, from white and yellow to azure and deep scarlet; and they vie in fragrance with the primrose and the violet. Some are natives of thickets in the cooler districts of Europe and Asia; some grow deep on the burning, arid, and sterile shores of islands in the torrid zone; some are found in the damp, gloomy, and sultry woods of equinoctial America; and some are indigenous among the gladioli and the ixias of Southern Africa. The number of species of the genus *amaryllis* grown in Great Britain is upwards of 30; and the total number known is about 40. All the species in Great Britain are ornamental; a large proportion are magnificently beautiful, and several are perfectly superb; yet only five—the white, the *Belladonna* lily, the pale-flowered, the long-leaved, and the Tartarian—are hardy, all the others being plants of the greenhouse or the stove. Some of the best known are those called the *Jacobea* lily, the Mexican lily, the Barbadoes lily, the revolute *amaryllis*, the *Belladonna* lily, and the long-leaved *amaryllis*.

AMAUROSIS, **GUTTA-SERENA**, or **GLASS-EYE**. The total blindness of horse, ox, or sheep, from the paralysis of the optic nerve. The pupil of the eye is unusually dilated, and is immoveable, bright, and glassy; yet the appearance of the eye is sometimes so slightly or almost imperceptibly altered, that the existence of the disease is de-

ected only by the effects of total blindness. Amaurosis is usually produced by determination of blood to the head, and therefore sometimes follows the disease called staggers. The pressure of blood on the base of the brain first injures the optic nerve, and then destroys its function. Any attempt to cure or alleviate amaurosis in the ox or the sheep would be absurd; and the instant it is ascertained to exist, the animal must be destroyed. Successful treatments of it in the case of the horse are on record, but very rarely occur. The seat of the disease is beyond our reach; and any effect produced on it must be achieved through the medium of the constitution. The most feasible remedies are bleeding, purging, and the administering of strychnine,—the last, noon and night, in doses first of half a grain, and afterwards cautiously and watchfully increased to two grains. But the proprietor of the animal ought to consider whether the exceedingly slender hope of success be worth the trouble and expense of attempting a cure. A blind horse is worth something, and might be damaged, as well as needlessly pained, by any such amount of operating on his constitution as might have even the slightest probability of restoring his optic nerve.

AMBER. A remarkable substance found in Prussia, which has for more than three thousand years excited the curiosity of naturalists and the avidity of traders. It is uncertain even at present whether it belongs to the animal or to the vegetable kingdom; almost all writers agree that it forms no part of the mineral. It is a sort of solid bitumen, very light, of a vitreous conchoidal fracture, and generally of a milky white, or yellow colour; although it is sometimes found brown or black, and sometimes quite opaque. It is combustible, evaporates, and, when heated or rubbed, diffuses an agreeable odour. *Succin* is that sort which is most crystallized and transparent; and what the Prussians term amber has a less vitreous fracture and a more earthy appearance. From *electron*, the Greek word for amber, is derived the term electricity; so that an insignificant fossil has, from its power of attracting light bodies, given its name to the cause of the most imposing and terrible phenomena in nature,—

“ The lightning’s lurid glare, and thunder’s awful crash.”

Heinitz supposes that its formation must be attributed to forests submerged by the ocean, and afterwards covered with sand; the resinous particles, being distilled into amber, and the rest of the wood forming a residuum, or *caput mortuum*. And what strengthens this supposition is, that wood is generally found near it, which renders its vegetable origin probable. The supposition of its mineral origin is disproved by distillation, and by the foreign bodies found in its substance. M. Schweigger, an eminent entomologist, has carefully examined the insects contained in the amber; and he has found that many of

them would belong to genera of insects now existing, but that none of them were specifically the same. Professor Germar of Halle has been occupied in a similar investigation, and he also thinks that none of them are identical with analogous species now living. M. Girtanner affirms, that amber is formed by a large ant, the *Formica rufa* of Linnæus. He conceives it to be a vegetable oil, rendered concrete by the acid of those animals, which inhabit old forests of fir-trees where the fossil amber is found. The amber, when first dug, is ductile like wax, and becomes hard on exposure to air. Certain it is, that no insect is so commonly found in amber as the ant. Wallerius asserts, that the black and dark-coloured amber is often found in the bowels of cetaceous fishes. Others imagine that it is produced by a fish or an aquatic animal. It is certain, however, that amber must have passed from the fluid to the solid state; for foreign substances, such as leaves, insects, small fish, frogs, water, pieces of wood and straw, are often contained in it; and it is most esteemed when it contains any of these substances. The Phœnicians were the first who navigated the North seas in search of this substance. By the ancients it was considered as valuable as gold and precious stones. Its value, at present, is much diminished, though it is still required in some manufactories; for, at Stolpe in Pomerania, and Königsberg in Prussia, workmen are employed in making from it small jewels, scented powder, spiritous acid, and a fine oil that is used as a varnish. Amber is exported to Denmark and Italy, but Turkey is the chief market for the commodity; and a certain portion of it is carried every year to the Holy Kaaba at Mecca. This substance has long been regarded with superstitious veneration by several of the northern nations of Europe, as well as in Asia Minor; but what gave rise to this we have not been able to trace. Among the peasantry of Scotland amber-beads have long been held as a complete antidote to the effects of witchcraft; and, in consequence, one or more beads of it were very commonly carried in the pocket. But, that it might have complete efficacy, it was considered necessary that it should be accompanied by the following couplet, written on paper, wrapped round the bead, and secured by a red silk thread:—

“ Lammar (amber) beads and red thread
Keep the witches at their speed.”

A twig of the mountain-ash, or rowan-tree, was supposed to have precisely the same effect. Among the higher classes in Scotland, in former times, amber-beads were much worn, and were always strung with red silk thread.

The quantity of amber annually found in Prussia amounts to more than 200 tons; and the revenue derived from it by the crown is £3,000 or £4,000. It is obtained on the Prussian coast, between Pillau and Palmnicken, on a tract of land about eighteen miles in length; and sometimes upon

the surface of the water, where it is collected by means of nets. It is, however, only after violent north and north-west winds that any large quantity is drawn to the shore. Quarries, or pits, have been opened at Dirschkemen, on the hills near the coast, and their produce is less variable. In digging for it, the first stratum is found to be sand, then clay, then a layer of branches and trunks of trees, then a considerable quantity of pyrites, whence sulphuric acid is prepared, and lastly a bed of sand, through which the amber is dispersed in small pieces, or collected together in heaps. It assumes various shapes, as that of a pea, an almond, a pear, and letters, very well formed; and even Hebrew and Arabic characters. It frequently occurs amongst coniferous fossil wood, in beds of brown coal. Hence some have regarded it as nothing else than an indurated resin derived from trees of the coniferæ family. It has also been found in Maryland and New Jersey. It is found in other places in the interior of Prussia; and one of the largest pieces of amber known was found at Schleppacken, about fifty miles from the Lithuanian frontier. It is fifteen inches in length, and seven or eight in breadth, and may be seen in the museum at Berlin. A specimen was found in the kingdom of Ava, in India, nearly equal in size to that of a child's head, and intersected in various directions by thin veins of carbonate of lime. Amber is also to be found in the high hills of Goldapp, seventy-five miles to the south-east of Königsberg, and in the heights and valleys on the Vistula, in the neighbourhood of Thorn and Graudenz. A large piece of amber was cast ashore, about twenty-five years ago, at Peterhead, in the county of Aberdeen, in Scotland.

The most remarkable properties of amber are, that, being rubbed, it attracts light bodies. The friction which elicits the electric fluid also renders amber visible in the dark. Dr. Wall remarked, that by rubbing amber upon a woollen substance in the dark, light was also produced in considerable quantities, accompanied with a crackling noise; and what is still more extraordinary, he adds, "This light and crackling seems in some degree to represent thunder and lightning." An essential oil is prepared from amber, and is of a dark colour, and very disagreeable odour; and this oil, by being rectified, loses some of its dark colour and bad odour, and retains its medical properties unchanged. The oil, either crude or rectified, is employed, in veterinary practice, generally in mixture with oil of turpentine or other oils, as an embrocation for sprains and bruises, and is given internally, in doses of from two drachms to half an ounce, as an antispasmodic.

AMBERGRIS. A substance much of the same nature as amber, but differing from it by its particular consistence, which nearly approaches to that of bees' wax; sometimes it is granulated, and appears opaque, or of a dark gray. Experi-

ments prove that it resembles amber in its nature. When analyzed, it is found to consist of phlegm, a volatile acid partly fluid, oil, and a little coaly matter. It dissolves more readily than amber in spirit of wine. It is most common in the Indian seas, on the eastern coast of Africa, Madagascar, &c., and it is found either floating on the sea, or cast on the sea-shore. In this substance, animal and vegetable remains are sometimes found, as, for instance, the parts of birds. The origin of ambergris is probably the same with that of amber. According to M. Aublet, in his '*Histoire de la Guiane*,' it is nothing more than the juice of a tree, hardened by evaporation; and if this be true, it is a substance which belongs properly to the vegetable kingdom. The tree which is said to produce it grows in Guiana. It is called *cuma*, but has not been examined by other botanists. When a branch is broken by high winds, a large quantity of the juice exudes; and if it chance to have time to dry, various masses (some of which have been so large as to weigh one thousand two hundred pounds, and more) are carried into the rivers by heavy rains, and through them into the sea; afterwards they are either thrown on the shore, or eaten by fish, chiefly by the spermaceti whale (*Physeter macrocephalus*). This fish swallows such large quantities of this gum resin, that it generally becomes sick, so that those employed in the catching of these whales always expect to find some ambergris in the bowels of the lean whales. Father Santes, who travelled to various places on the African coast, says, in his '*Æthiopia Orientalis*,' that some species of birds, of whales, and of fish, are fond of eating this substance; and the same assertion has been made by Bomare and various other authors. This accounts for the claws, beaks, bones, and feathers of birds, parts of vegetables, shells and bones of fish, and particularly for the beaks of the cuttle-fish which are sometimes found in the masses of this substance. M. Aublet brought specimens of this gum resin, which he collected on the spot, from the *cuma* tree at Guiana. It is of a whitish-brown colour, with a shade of yellow; while it melts and turns like wax in the fire. M. Pouelle examined very carefully this substance brought over by M. Aublet, and found that it produced exactly the same results as amber. These observations seem to place it beyond a doubt, that both amber and ambergris are vegetable products, and that naturalists were mistaken in supposing these substances to be of an animal nature, from having found them in the intestines of whales.

AMBLE,—Scoticè, *Canter*. A kind of pace in which the horse moves alternately his two right legs and his two left. In this pace, the animal maintains no proper equilibrium between his two sides, but supports himself by a forced oscillation from side to side, and in consequence is compelled to practise greater agility, and to keep his feet much nearer the ground, than in any

other kind of pace. If, in the amble, he lifted his feet as high as in the trot or in the walk, he could possess no sort of equilibrium, and would be certain to fall upon his side. In the amble, also, he practises great rapidity of action, and not only lifts his hind-leg simultaneously with the fore-leg, but sets it down from a foot to a foot and a half in advance. The further the hind-leg extends beyond the spot on which the fore-leg grounded, the more easily does the horse amble, and the more rapidly does he proceed. The amble is very fatiguing to the horse, but proportionally easy to the rider, and will comfortably carry over a distance of twenty miles an inexperienced horseman whom a trot would gall in a distance of ten or twelve miles. In the trot, the fore-leg resists the lifting up of the hind-leg, and occasions a jolt to an indifferent rider, and a certain roughness to the whole of the horse's motion; but in the amble, the fore-leg moves so simultaneously with the hind-leg as to offer no resistance, occasion no jolt, and render the whole motion as smooth and flowing as the oscillation of the most elastically mounted carriage. Horses which naturally amble never trot, and seem to labour under some malformation or defect of constitution; and most good horses, which have been overworked and are on the decline, appear to prefer the amble to any other kind of rapid pace. Colts also very often amble, especially when they exert themselves, and are not strong enough to trot or gallop. Various methods of discipline are practised for bringing a young horse to amble. Some try to toil him in his foot pace through new-ploughed fields, and compel him, as a means of relief, to lift alternately his two right feet and his two left; but they are very apt to weaken the animal, to lame him, or to give him a permanent halt. Others attempt so to stop him in a gallop or a trot as to throw him accidentally into the ambling pace; but they may spoil a good mouth and rein, and are liable to give him a hoof-reach or sinew-strain. Some incumber the horse with very heavy shoes or with thick pieces of lead about the fetlock pasterns, intending to force him into an ambling motion by the mechanical action of the weights; but they do not consider that both expedients are liable to make him strike short with his hind-feet, and that the pieces of lead around the fetlock pasterns may give incurable strains, or crush the coronet, or breed ring-bones. Some heavily load the animal with side-weights, designing to force him mechanically into a sort of oscillating or swinging motion; but they are very apt to sway the back, to overstrain the fillets, or to inflict other serious evils. Some endeavour to make him amble in hand before they mount him, and, when he treads false, to check him in the mouth with the bridle-hand, and correct him with a rod on the hinder hoofs or under the belly; but if he be a spirited animal, they are in great danger of spoiling him before he can possibly understand what they

wish him to do. "The best method seems to consist in trying with your hands, by a gentle and deliberate racking and thrusting of the horse forwards, by helping him in the weak part of his mouth with your snaffle, which must be smooth, big, and full, and correcting him first on one side, then on the other, with the calves of your legs, and sometimes with a spur. If you can by this means make him fall readily into an amble, though in a shuffling and disorderly manner, much labour will be saved; for that aptness to amble will render the trammel more easy to him, and he will find the motion without stumbling or being frightened." [*Society of Gentlemen's Complete Farmer.*]

AMBROSIA. A genus of hardy annual weedy plants, of the gourd tribe. Five species are natives of North America; one species is a native of Italy; and four other species known to botanists have not been seen in England. They grow from three to eight feet high; and for no reason but because their leaves, when bruised, emit a grateful fragrance, they have been absurdly called ambrosia,—a name which originally designated the fabulous food of immortals, and which modern usage poetically applies to any edible substance of the most exquisite flavour.

AMBURY. See **ANBURY.**

AMELANCHIER. A small genus of ornamental deciduous shrubs, of the rose tribe. It was formerly included in the medlar genus, *Mespilus*, and is very nearly allied to the genus *Pyrus*, but is curiously distinguished from the latter by the peculiar form of its seed-vessels. Three species, the alpine, the snowy, and the oval-leaved, are cultivated in Great Britain; and a fourth species is known to botanists, but has not been introduced. The alpine species is a native of Austria, France, and Italy, and grows to the height of six feet; the snowy is a native of North America, and grows to the height of twelve feet; and the oval-leaved is also a native of North America, grows to the height of eight feet, and was introduced so late as the year 1800. The stems of the alpine or most common species, are slender and slightly ramified; the young branches are of a reddish purple colour; the leaves are oval, serrated, three-quarters of an inch in length, green above, and woolly underneath; the flowers are white, and are produced in bunches from the end of the branches; and the fruit—sometimes called the New England quince—is small, black, and sweetish, and is often ripened in autumn. The Amelanchier is a decidedly beautiful shrub.

AMEL-CORN. See **SPELT.**

AMELIORATING CROPS. Such crops as are supposed to improve the lands on which they are cultivated. The most common ameliorating crops are carrots, turnips, artificial grasses, and most others of the green or fallow class; yet though some of them occasionally ameliorate land, by altering the chemical condition of the soil, by choking weeds, and by intermixing with the soil a very large amount of manure, they rarely

benefit land by their direct influence, but, in general, are merely the occasion of improvement by manuring and cleaning. An ameliorating crop either destroys weeds by taking entire possession of the soil; or occasions weeds to be destroyed, oxygen to be absorbed, and inert matter to be decomposed, by frequent workings of the soil; or exhausts mischievous excrementitious deposits of preceding cereal crops; or makes such excrementitious deposits of its own as are useful to succeeding cereal crops; or occasions a thorough preparation of the soil, by means of previous manuring and a series of ploughings, for subsequent cereal crops; or brings large contributions of manure, and a great amount of useful mechanical pressure, by its being fed off; or contributes the whole of its own substance to the soil by being ploughed in as a green manure; or makes large returns to the soil by contributions of its substance to the dung-heap of the farm-yard. See ROTATION and FALLOW.

AMENTACEOUS TREES. Trees whose blossoms have the form of amenta or catkins. Each series of characteristic blossoms hangs somewhat in the form of a cat's tail; and consists of an aggregation of scaly or cottony flowers, without either calyx or corolla. If the cone-bearing trees be excepted, the amentaceous trees constitute the great body of the timber trees of Europe; they comprise the genera of the alder, the birch, the willow, the poplar, the liquidamber, the plane, the hornbeam, the hop-hornbeam, the chestnut, the beech, the hazel, and the oak; but, in consequence of very considerable differences in the form of their amenta, they have been subdivided by modern botanists into four tribes, represented by respectively the birch, the willow, the plane, and the oak.

AMERICAN ALOE,—botanically *Agave*. A genus of gorgeous, evergreen, tender shrubs of the pine-apple tribe. The known species are ten in number; two of them, *karatto* and *vivipara*, are biennials; and all the others are perennials. Yet, if mere length of duration be considered, all are perennials; and if monocarpous habit be considered, all are biennials. See the article BIENNIAL PLANTS. All are natives of America,—chiefly the countries around the Gulf of Mexico; and all closely resemble one another, yet vary in height from three feet to about thirty. The common or great American aloe, *Agave Americana*, was introduced to Britain in 1640; and has long been a great favourite in our greenhouses, and a popular succulent throughout Europe. Its form is similar to that of the yucca and the aloe, but more massive and elegant. Its stem, if it can be said to have one, is scarcely distinguishable from the crown of the root; its leaves are toothed, spiny, spreading, and very fleshy, and sometimes measure ten feet in length, fifteen inches in breadth, and eight inches in thickness; its flower-stem is from twenty to thirty feet high, sends out curved branches on all sides like candelabra, and grows at the surprising rate of six inches or upwards every twen-

ty-four hours; and its flowers have a greenish yellow colour, come out in thick clusters at every joint of slender shoot of the branches, have six long stamina crowned with yellow summits and placed round the style, and sometimes on a single plant number considerably upwards of two thousand. A plant, when in flower, is an object of surpassing beauty; and if properly managed, will retain all its freshness, and produce a succession of flowers, during about three months. The American aloe was formerly believed by British gardeners to be capable of flowering only in its hundredth year, and is still popularly believed to be capable of flowering only in its fiftieth year; but it really flowers in its native country in its ninth or tenth year,—it flowers in Great Britain in any year from its fifteenth or twentieth to its sixtieth or seventieth, or never flowers at all, simply according to the treatment it receives;—and were it managed with due skill and care, it would probably be, in all instances, brought in a very few years into a flowering condition. But any one plant never flowers a second time, each plant thoroughly exhausting itself by fructification, and immediately perishing, in the same manner as an annual or a true biennial. Its flower-stem and young shoots, in the earlier stages of their growth, have the appearance of a gigantic asparagus; and in their full-grown condition, look, at a little distance, like a slender and pyramidally outlined tree. A curious observer, however, may from year to year see hundreds of American aloes, before enjoying the exquisite luxury of seeing either the flowers or the flowering-stem of even one plant.

The American aloe grows like an indigenous plant in Sicily, the south of Italy, and the south of Spain. It is in general use, throughout southern and central Italy, as an ornament to piers, parapets, and the exterior of houses; and imitations of it in painted copper, are used for the same purpose throughout Lombardy. It is sometimes grown for hedges in Spain, Portugal, Sicily, Calabria, and the West Indies. The juice of its leaves, after being inspissated and mixed with ley ashes, is used, in Jamaica, as a substitute for soap, and lathers with salt water as well as with fresh. Its leaves are used, in the West Indies, for scouring floors and kitchen utensils. The decayed interior substance of the decayed flower-stem is used for tinder. The fibres of the leaves, prepared similarly to those of flax, are manufactured into strong thread. The Indians use its prickles as substitutes for needles; they eat its flower-buds in both a boiled and a pickled condition; they employ some parts of it for medicine, and convert its roots with sugar into sweetmeats; they manufacture from it thread, ropes, cloth, and paper; and they use its flower-stems for props and rafters to their houses, its leaves for thatch or covering, and both flower-stems and leaves for fences. The Mexicans extensively cultivate it for the sake of its sap, and manufacture

from this their favourite intoxicating drink called pulque. "The plants are set about five or six feet asunder, and, in favourable situations, come into bloom in about ten years, at which period the valuable liquor they produce is to be procured. As soon as the cultivator perceives the plant preparing to throw up its long flower-stem, he cuts out the leaves which form its centre, and hollows it out in the shape of a bowl, at the same time removing most of the other leaves, so that the whole sap destined for their supply flows to the great stem, and is received by the bowl-shaped cavity, into which it runs with such rapidity as to require to be emptied several times a-day, for a space of two months. The liquor, when collected, is placed in jars or skins; it undergoes a slight fermentation, which takes place in a few days, and is then fit for immediate drinking. Strangers prefer it when fresh, but the natives seldom use it till it has acquired a strong taste, and a disagreeable, fetid smell, denominated fuerte, when it is esteemed in high perfection. This is also called *vino merca*; and resembles Scotch whiskey in colour and flavour; but it has a little more flavour of alcohol." [*Bullock's Mexico.*] The sap thus used by the Mexicans also flows very copiously from the flowers in Great Britain; it attracts myriads of bees, and may be collected in vessels; and, after being preserved for a few days in bottles, it is an excellent cordial, but it eventually becomes acidulous, fetid, and disagreeable. — *Loudon's Encyclopædia of Plants.* — *Miller's Gardener's Dictionary.* — *Bullock's Mexico.* — *Loudon's Gardener's Magazine.*

AMERICAN BLIGHT. See APHIS.

AMERICAN COWSLIP, — botanically *Dodecatheon Mædia*. A beautiful flowering plant, of the primrose tribe. It blooms from April till June, and afterwards dies down to the root till next spring. It thrives best in light, loamy, moderately moist soil, in a shady situation; but is not very easily kept. There is only one species.

AMERICAN CRANBERRY. See CRANBERRY.

AMERICAN CRESS, — botanically *Barbarea Præcox*. An evergreen, herbaceous, kitchen-garden plant, of the cruciferous family. It is cultivated in a number of gardens as a spring salad. The name of American cress is also given to the Virginian pepperwort, *Lepidium Virginicum*, a co-species of the common cress.

AMERIMNUM. A small genus of tender, evergreen shrubs, of the pea tribe. They grow from ten to twelve feet high; and are natives of the West Indies and South America. The timber of one of the species has a fine greenish brown colour, takes a good polish, and is imported to Great Britain under the name of American ebony.

AMETHYSTEA. A pretty, blue-flowering, hardy annual plant, of the labiate tribe. It has a height of 18 inches, and is a native of Siberia.

AMMOBIUM. A pretty, half-hardy, herbaceous plant, of the composite family. It has some resemblance to the gnaphaliums or common

everlastings; and was recently introduced from New Holland.

AMMONIA. The volatile alkali. It acts a very prominent and important part in most of the processes of agricultural chemistry, and ought to be thoroughly studied and well understood by every farmer. It does not naturally exist in a separate condition, and usually acts in combination with acids in the form of salts, with water in the form of liquid, with atmospheric air and vapours in the form of gas, or with decayed animal and vegetable matters in the form of farm-yard manure; yet it requires to be understood, not only in these combinations, but also as a separate substance.

Ammonia is easily obtained from the sal ammoniac of commerce, or by the dry or destructive distillation of animal substances. It is a transparent, colourless, and consequently invisible gas; and possesses elasticity and the other mechanical properties of the atmospheric air. It consists by weight of 0.125 of hydrogen and 1.75 of nitrogen; or by atomic combination of three atoms of hydrogen and one atom of nitrogen. It possesses an exceedingly pungent smell, and a very acrid taste; and constitutes all the pungency and acidity of the well-known spirits of hartshorn, sal-volatile, and smelling salts. It extinguishes combustion, and speedily kills any animal which is immersed in it. Water very rapidly condenses it; and can easily dissolve a quantity of it equal to one-third of its own weight, or 460 times its own bulk; and when brought into contact with a tubeful of it, water rushes into the tube with explosive velocity. Ammonia, when in contact with other bodies, or when operated upon by various elementary substances and by light, heat, and electricity, is capable of undergoing an absolute multitude of transformations; and in consequence passes into such varied combinations, makes such great transitions, and assumes such different and contrasted forms as no human mind but a chemist's would suspect. When it is perfectly dry and mixed with oxygen, the electric spark explodes it, and converts it into water and nitrogen, the hydrogen of the ammonia combining with the oxygen to form water, and the nitrogen of the ammonia being released and left free; yet if the oxygen with which the ammonia is mixed be in excessive quantity, it acidifies a portion of the nitrogen into nitrous acid. Ammonia forms neutral compounds or soluble salts with all the acids; and when in contact with certain other substances, it completely loses its alkaline character, and assumes exceedingly various and even opposite forms. In many of its combinations and transformations, it is a healthful stimulant; but, in others, it passes into the most virulent poisons. Pure ammonia, when transmitted through charcoal in combustion in a tube, forms prussic or hydrocyanic acid; and formate of ammonia, when under the influence of a high temperature, changes, without separation of its

elements, into prussic acid and water. Ammonia forms urea, or the characteristic substance of urine, with cyanic acid, and a series of crystalline compounds with the volatile oils of mustard and bitter almonds; and it changes into splendid blue or red colouring matters when in contact with the bitter principle of the bark of the apple tree's root, with the sweet principle of the lichen *dealbatus*, or with the insipid matter of the true dyer's orchall. But by far the most interesting transformation of ammonia—and one which the other transformations are of value chiefly for illustrating—is its evolving itself from the putrefaction of all animal matter, and contributing its azote to the formation of gluten, albumen, and other nitrogenous substances of the most nutritious parts of plants.

Ammonia achieves its grand office on the farm, not alone as a principal ingredient in all animal manure, but as an element in atmospheric vapours, in rain, and in snow. It is the final product of the decay of all animal substances, and goes off from their decomposition as a gas in union with carbonic acid into the atmosphere. In the tropics, indeed, it frequently combines with oxygen to form nitric acid, and therefore suffers a transformation into the very opposite of its proper or alkaline character; yet even there it ascends largely, and in the other zones of the world it ascends wholly, into the atmosphere in its strictly ammoniacal condition, and becomes dissolved in the vapours which descend to the earth in rain and snow. Nitrogen is a very large element in every animal body; it is separated from the other elements in every process of decomposition, whether by exudation or excrementation in the living body, or by putrefaction in the dead carcass; it has a stronger affinity for hydrogen than for any other element; and on being liberated from any animal organism by decomposition, it instantly rushes into combination with the hydrogen of any aqueous matter in its vicinity, and so forms ammonia, the simplest and the most facilely constituted of all nitrogenous compounds. As rapidly therefore as any animal substance decays, so rapidly does ammonia rise out of all its nitrogen, and either combine with adjacent acids to form ammoniacal salts, or mount into the atmosphere as a gas. Its gaseous evolution, in the instances of old urine, stable dung, and some others, is so pungently and stingingly sensible as to be known to every observer; and, though not sensible in other instances, may either be inferred from analogy, or proved by appeal to some general facts,—and principally to the existence of a larger proportion of ammonia in rain-water than can be accounted for upon any other hypothesis.

"Experiments made in this laboratory with the greatest care and exactness," says Dr. Liebig in reference to his own laboratory at Giessen, "have placed the presence of ammonia in rain-water beyond all doubt. It has hitherto escaped

observation, because it was not searched for. All the rain-water employed in this inquiry was collected six hundred paces south-west of Giessen, whilst the wind was blowing in the direction of the town. When several pounds of it were distilled in a copper still, and the first two or three pounds evaporated with the addition of a little muriatic acid, a very distinct crystallization of sal ammoniac was obtained; the crystals had always a brown or yellow colour. Ammonia may likewise be always detected in snow-water. Crystals of sal ammoniac were obtained by evaporating in a vessel with muriatic acid several pounds of snow, which were gathered from the surface of the ground in March, when the snow had a depth of ten inches. Ammonia was set free from those crystals by the addition of hydrate of lime. The inferior layers of snow resting upon the ground contained a quantity decidedly greater than those upon the surface. It is worthy of observation that the ammonia contained in rain and snow water possesses an offensive smell of perspiration and putrifying matter,—a fact which leaves no doubt respecting its origin. Hünefeld has proved that all the springs in Greifswalde, Wick, Eldena, and Kostenhagen, contain carbonate and nitrate of ammonia. Ammoniacal salts have been discovered in many mineral springs in Kissingen and other places. The ammonia of these salts can only arise from the atmosphere. Any one may satisfy himself of the presence of ammonia in rain by simply adding a little sulphuric or muriatic acid to a quantity of rain-water, and by evaporating this nearly to dryness in a clean porcelain basin. The ammonia remains in the residue in combination with the acid employed; and may be detected either by the addition of a little chloride of platinum, or, more simply, by a little powdered lime, which separates the ammonia, and thus renders sensible its peculiar pungent smell. The sensation perceived upon moistening the hand with rain-water, so different from that produced by pure distilled water, and to which the term softness is vulgarly applied, is also due to the carbonate of ammonia contained in the former." "We cannot doubt," says Saussure, "that ammonia exists in the atmosphere; for we know that sulphate of alumina (common alum) is gradually converted into ammoniacal alum by exposure to the air." Other distinguished chemists have repeated Dr. Liebig's experiments upon rain-water; and have, like himself, not only found it to contain ammonia, but very distinctly recognised in the ammonia yielded by it the offensive odour of animal perspiration, excrements, and putrefaction. The ammonia evolved from the decay of animal matter rushes into combination with carbonic acid to form carbonate of ammonia, or the vapour or volatile matter of what is popularly termed smelling salts; and in this state, it is so exceedingly soluble in water that it must immediately deliquesce in the humid vapours with which it meets, and be held in mechanical

mixture with them till they bring it back to the ground in the first fall of rain or snow. Rain-water, in consequence, must always contain ammonia, and possess a decidedly manurial power; yet less in winter or spring than in summer,—less on the second day of any constant rain than on the first,—less after a brief than after a long interval of drought,—and most of all in a thunder-shower at the end of a long tract of dry and sunny weather. Dr. Liebig supposes the quantity of ammonia in a pound of rain-water to amount, on the average, to about one-fourth of a grain; while the reviewer of his “Organic Chemistry” in the Quarterly Journal of Agriculture, computes it to amount to only .092 of a grain; and they very probably differed in their estimates, solely on account of the former having used the rain-water of occasional showers, and the latter the rain-water of frequent rains. On Dr. Liebig’s computation applied to the rain-gauge of Germany, the quantity of ammonia annually deposited by rain upon every 26,910 square feet of land is upwards of eighty pounds; and according to his reviewer’s computation applied to the rain-gauge of Scotland, the quantity of ammonia and of common salt annually deposited by rain upon every acre of land is respectively 71.8 and 641.4 pounds. Some portion of the ammonia which falls, indeed, will be re-evaporated with the water; but quite enough of it must sink into the soil and operate upon vegetation, to act as both a stimulating and an alimentary manure,—at once preparing the materials around it for the plant’s assimilation, disposing the spongioles to absorb the food presented to them, and entering the interior of the plant chiefly to contribute its azote to the plant’s nitrogenous secretions, partly to undergo other transformations in the economy of the plant’s growth and maturation, and partly to remain unaltered and act as an interior stimulant.

The quantity of azote in each eighty pounds of ammonia, which Dr. Liebig computes to be annually deposited by rain upon every 26,910 square feet of land, is so great as seventy pounds; and this is much more than the quantity contained in all the gluten and vegetable albumen of any average crop of wood, hay, or beet-root which that extent of land can produce, yet less than the gluten and vegetable albumen of the straw, roots, and grain of a crop of corn. The mere ammonia of rain-water, therefore, affords an ample supply of azote for trees, grasses, and green crops, but must be supplemented with nitrogenous manures, such as those of the farm-yard, for all cereal crops; yet, in every case, it is so strongly and even necessarily alimentary as to afford a very broad and easy explanation of the fact, that artificial waterings with the water of streams are generally a miserable substitute for the rains of heaven. [See also the articles AERATION and AZOTE.] The juices of maple-trees, birch-trees, and beet-root, when mixed with lime,

emit a strong odour of ammonia; the products of the distillation of flowers, herbs, and roots with water, and all extracts of plants made for medicinal purposes, contain ammonia; the transparent, gelatinous pulp of the unripe almond and peach, when treated with alkalies, emits a large proportion of ammonia; the fresh or unwithered leaf of the tobacco plant, contains ammoniacal salts; the juice of a wounded vine, evaporated with a few drops of muriatic acid, evolves much ammonia; and, in short, the juice of the roots, the stem, the blossoms, and the fruit of all albuminous plants, in an unripe stage, have been proved by experiment or may be inferred from analogy, to contain both ammoniacal and saccharine matters, and to be in consequence under the precise chemical conditions for forming azotised secretions and products. But while the plants are ripening, the juices gradually dry up, the ammonia diminishes in quantity, the sugar disappears along with the ammonia, and the permanent nitrogenous products of the plants, such as albumen, gluten, and vegetable casein, comprising all the most nutritious and valuable constituents of most cultivated crops, are evolved.

Animal manure exerts a very complex action upon plants; yet, as regards its supply of nitrogen, or its agency in assisting the formation of nitrogenous products, it acts only by its contributions of ammonia. Either an increased quantity of any one kind of it, or the use of any variety of it which is richer in ammonia than varieties previously used, occasions both an increase in the number of grains or seeds in a crop, and an enlargement of the proportion which their nitrogenous contents, such as gluten and albumen, bear to their other constituent elements. Wheat grown on a soil manured with cow-dung—a manure which evolves less ammonia than most other animal manures—has been found to contain only 11.95 per cent. of gluten, and 62.34 per cent. of amylin or starch; while wheat grown, in the same circumstances, on a soil manured with human urine—a manure remarkably rich in ammonia—has been found to contain 35.1 per cent. of gluten, or nearly three times the proportion contained in the other. Urea, the most prominent ingredient in urine, is converted by putrefaction, or under the influence of heat and moisture, into carbonate of ammonia, or the very form of ammoniacal salt which exists so largely in solution in rain-water; native urine contains also a proportion of both the phosphate and the muriate of ammonia; so that putrid urine is a singularly powerful combination of ammoniacal forces, and may easily be understood to elicit the formation of threefold more gluten in a grain crop than can result from the action of so comparatively feeble an ammoniacal manure as cow-dung. Guano operates as a mighty manure almost exactly on the same principle; for, when genuine, it consists solely of the urate, the oxalate, the phosphate, and the carbonate of ammonia, and a few

earthy salts. See URINE, GUANO, and MANURES. Even plants, such as tobacco, goosefoot, borage, and sunflower, which require nitrates as necessary constituents, owe their nitric acid to the transformation of ammonia, and thrive only when they are fed with large supplies of ammonia, and when the action of the sun's rays is sufficiently powerful so to disengage oxygen within their leaves and stem that it may combine with the ammonia to form nitric acid.

Ammonia, in its ordinary form of carbonate, is exceedingly volatile, and makes a gradual and constant escape from all such animal manure as lies on the surface of the ground, or is otherwise exposed to the open air. All the pungent portion of the odour from stables and dung-heaps consists wholly of particles and volumes of ammonia, in the act of escaping and of becoming diffused through the atmosphere. If any quantity of animal manure lie for a sufficient time either in a heap or distributed over the mere surface of soil, it will lose all its ammoniacal matter, and become a mere carbonaceous residue closely similar in nature to charcoal. But, on the contrary, when the ammonia yielded by any substance is either evolved in the form of a sulphate, a phosphate, a muriate, or an oxalate, or is reduced by foreign combination from a volatile to a fixed condition, it is a permanent or inseparable constituent of manure, and is expended, without one particle of loss, in stimulating, nourishing, and maturing the processes of vegetation. Sal ammoniac or muriate of ammonia is a familiar instance of a fixed salt of ammonia, possessing full ammoniacal influence upon plants, and yet perfectly free from both volatility and ammoniacal odour; and a soluble sulphate of ammonia of precisely kindred properties to this salt is, jointly with carbonate of lime, formed by the combination of gypsum with carbonate of ammonia, either as existing in rain-water or as immediately evolved out of animal decomposition. The strewing of stables and the sprinkling of dung-heaps with gypsum, therefore, are practices which both prevent the disagreeable odours of putrefaction and save a large proportion of the most valuable manure; and the strewing of gypsum upon a meadow so completely fixes the portion of carbonate of ammonia in rain-water which would otherwise go off in evaporation, as to render the grasses both luxuriant in growth and eminently nutritious in constitution.* "In order

* When putrid urine or the draining of dunghills, in a state emitting an ammoniacal smell, is distributed over an arable field for manure, a sprinkling of gypsum or of chloride of calcium ought to be made upon the field to convert the ammonia into a fixed salt. But a better practice is to fix all the ammonia, by means of gypsum, chloride of calcium, superphosphate of lime, muriatic acid or sulphuric acid, in the stable, in the water-closet, and in all other places where the ammonia is generated. A basin of concentrated muriatic acid, properly situated in a water-closet, will prevent disagreeable odours, and convert all the ammoniacal gases of the place into sal-ammo-

to form a conception of gypsum," says Dr. Liebig, "it may be sufficient to remark that 100 lbs. of burned gypsum fixes as much ammonia in the soil as 6,250 lbs. of horse's urine would yield to it, even on the supposition that all the nitrogen of the urea and hippuric acid† were absorbed by the plants without the smallest loss, in the form of carbonate of ammonia. If we furnish to a field 40 lbs. of gypsum, and if we suppose that the tenth part of this enters into plants in the form of sulphate of ammonia, we would actually supply nitrogen sufficient for 100 lbs. of hay, 50 lbs. of wheat, or 60 lbs. of clover. Water is absolutely necessary to effect the decomposition of the gypsum, on account of its difficult solubility, (one part of gypsum requires 400 parts of water for solution,) and also to assist in the absorption of the sulphate of ammonia by the plants: hence it happens that the influence of gypsum is not observable on dry fields and meadows; while the gaseous carbonate of ammonia formed by the decay of animal manures on such fields, on the other hand, does not fail in producing a favourable effect. The decomposition of gypsum by carbonate of ammonia does not take place instantaneously; on the contrary, it proceeds very gradually; and this explains why the action of the gypsum lasts for several years." See GYPSUM. Alumina and peroxide of iron form solid compounds with ammonia; salts of alumina or iron combine with ammonia to form true ammoniacal salts; and minerals containing alumina or oxide of iron attract ammonia from the atmosphere and retain it. Soils, therefore, which contain burnt clay or oxides of iron absorb ammonia from both the atmosphere and rain-water, make such chemical combinations with it as to constitute fixed salts, contribute it in these combinations to act manurially upon plants, and thus perform the same fertilizing office as a mineral acid would do, if extensively spread over their surface. Coal soot, as is well known, exerts a highly beneficial action as a top-dressing, when not employed in a greater proportion than about 20 or 25 bushels per acre, and is apt to stunt and scorch and kill vegetation when employed in excessive quantity; and it owes both its beneficial and its mischievous power to the presence of a large proportion of sulphate of ammonia,—this salt acting fertiliz-

nia; and any of the other substances which we have named—and which are both low in price and easy of being procured—will collect and concentrate the ammoniacal gases of the stable, the cow-house, the piggery, the poultry-yard, and every other part of the farmery. The ammonia which usually escapes in the form of gas in the stable is not only lost to the farmer, and noxious to the eyes of horses, but it works a slow and steady destruction of the walls of the edifice, combining with the lime of the mortar to form nitric acid, and converting the whole cement of the lime into the condition of soluble nitrate. This mischievous chemical process in stables is known in Germany by the special name, *salpeterfrass*.

† Hippuric acid is a constituent of the urine of herbivorous animals; and, during putrefaction, is decomposed into benzoic acid and ammonia.

ingly in moderate doses, and in mixture with the carbonaceous matter of the soot, and possessing, in large doses, a degree of energetic causticity which operates with destructive violence on the tender organs of plants.

Ammonia, in all its manurial action, appears to operate best in a state of natural mixture with the various ingredients of farm-yard dung, and next best in a state of thorough mixture with the several vegetable and mineral ingredients of a long-wrought arable soil; so that, in order to its most beneficial effects being developed, it either ought never to be distributed in a separate or concentrated condition, as in that of salts, guano, or putrid urine, or ought, previous to distribution, to be thoroughly mixed with a large proportion of loamy and vegetable soil. The nitrogen which it supplies to plants requires to be in combination with certain other elements, in order to serve as the most suitable food or the peculiar nourishment of animals; and these other elements are usually furnished in the most effective proportions either by average farm-yard manure or by a complex and thorough mixation of chemical manures with the soil of arable lands or the virgin soil of forests. Ammonia, though always useful and often indispensable, does by no means require to be in every instance supplied to the ground even as an ingredient of farm-yard manure, and still less in any such concentrated form as that of guano, putrid urine, ammoniacal salts, or ammoniacal water; for when any soil, whether newly reclaimed from the forest, or enriched by prolonged fallow, or worked into prime condition by judicious cropping, contains a sufficient supply of the other ingredients required for combination with nitrogen, the ammonia obtained from the atmosphere may be perfectly ample for every purpose of luxuriant vegetation. See ALUMINA, AZOTE, HUMUS, MANURE, and FOOD. The action of an artificial supply of ammonia, even in the main capacity of this substance as a source of nitrogen, is limited, like that of humus as a source of carbonic acid, chiefly to an acceleration and rarely to an augmentation in the development of our cultivated plants; and when the supply is made in any incautious or concentrated form, it overstimulates the plants to the diminution or exhaustion of their vital energy, or even exerts such a caustic power upon their roots or foliage as speedily to kill them. Any ammonia, exhibited to plants in the form of a caustic vapour, is certain to peril their vegetation. Ammoniacal water, such as is obtained in the manufacturing of coal gas, though used with a highly fertilizing effect in various capacities, and particularly as a top-dressing to grass lands, yet requires to be employed with considerable caution, and, if administered in too great strength, will work utter mischief and disaster. This liquid, as procured at the public works, is of three different strengths, and might, in any instance, have its strength tested by instruments;

yet it ought never to be applied till so far diluted with rain or river water that it will not, when tested on a grass sward, farther discolour the narrow root-leaves of any of the grasses than slightly to lighten the tinge of their verdure. Even genuine guano, in spite of its well-established and very great power as a fertilizer, possesses such a caustic superabundance of ammoniacal matter, that, if applied to the soil in an undiluted state or not well mixed with a very large proportion of mineral ingredients, it will seriously injure most kinds of plants, and rapidly kill not a few. Yet the fixed salts of ammonia, particularly the sulphate, the muriate, and the phosphate, require, for quite an opposite reason, to be thoroughly diluted with foreign matters, or administered only as ingrediential parts of compound manures; for when exhibited in powder, in solution with water, or in mixture with only a small proportion of soil or other mineral diluent, they remain in a chief degree inactive, and are but very limitedly absorbed by plants. The true cause of their efficiency to any extent in the soil is believed by Boussingault to be their reconversion, by means of calcareous matter, into carbonate of ammonia; and as this reconversion is invariably resisted in the laboratory or upon the surface of the ground, and takes place only in the peculiar and complicated circumstances of their contact with other manures and partial exclusion from the air in diffusion through the soil, they exert their ammoniacal force upon vegetation just or very nearly in the degree of their removal from an undiluted or unmixed condition. A true knowledge of the complicated relations of ammonia, will thus tend to fix attention upon it chiefly as an ingredient in rain-water and in compound manures, and will inculcate extreme caution respecting its undiluted or concentrated artificial use.

At a recent meeting of the French Academy of Sciences, M. Boussingault made a communication relative to a new ammoniacal manure. Having remarked that magnesia, the basis of which has always been regarded as injurious to vegetation, was found in the ashes of all vegetables, and in a proportion in accord with the quantity of phosphorus also found in the ashes, and of that of the azote, which enters into the composition of plants, he was led to infer that vegetables must assimilate with ease and advantage the ammoniated-magnesian phosphate. Being desirous of verifying this by experiment, he planted on the 1st of May last some early maize, which had already germinated in two series of pots, into the half of which he had poured 15 grammes (about half an ounce) of double phosphated salt for each pot. The two series of pots were then placed in the open ground. During the first twenty-five days the vegetation was the same with both series; after that there was a difference in favour of the pots which had been watered with the phosphate. On the 25th of

July the plants in them were double in height to those of the other series, and the diameter of the stems was two-thirds thicker. By the 25th of August the proportion had diminished; the height of the plants watered by the phosphate was then only one-third greater, and the size of the stems double. At the moment of their coming to maturity, the phosphated plants bore two sound ears, and one that had failed to come to maturity; the other plants had only two ears each—viz.: one complete, and one that had failed. This was not all; each grain of the ears of the phosphated plants was double in weight to that of the non-phosphated plants. M. Bous-singault concludes, therefore, and with great reason, that the salt in question may be used with great advantage as an artificial manure.

Diluted ammoniacal water, in the proportion of an ounce of the liquor ammoniæ of the shops to a pint of rain or river water, has of late years been successfully employed for checking the vegetative power of potatoes, and prolonging their suitableness for food. Potatoes immersed during four or five days in this liquid, retain all their edible properties unimpaired throughout a twelve-month; they suffer no apparent effects except the desirable ones of postponed vegetation and improved appearance, flavour, and mealiness; and they so completely lose by volatilization all the ammonia which they absorbed, that the most fastidious person could not detect the fact of its ever having been present. The action of the liquid upon them makes no chemical change on their composition, but merely consolidates their substance and extracts their moisture. The potatoes, immediately after their immersion, require to be spread in an airy place to dry; and potatoes so used, and after being kept ten months in a warm kitchen closet, have been found perfectly good. This easy and cheap process is of great value for the exportation of potatoes to the tropics, for adding to the comforts and the healthful diet of seamen, and for providing private stocks of fine edible potatoes for the use of families during the scarce season from March till July. Immersion in a strong solution of salt and water produces exactly the same effects, but requires to be followed by frequent washings and steepings in order to the removal of the whole of the salt. If potatoes immersed in diluted ammoniacal water be not removed at the end of five days, but allowed to remain in the solution during three weeks, they are tough and shrivelled when removed, and assume a totally new character when dried,—much consolidated in bulk, greatly deprived of their natural properties, and, when boiled, assuming the appearance of sago or starch, but, when used dry and uncooked, having the flavour of meal and some of the apparent properties of corn.

Ammonia water kills animals of all kinds, and has recently been found very serviceable for destroying slugs in fields, vermin in store-houses,

and insects in hot-houses. When used for destroying rats, it is far superior to traps, and needs only to be applied to the rats' holes; and when used for destroying insects, it is at once cheaper, more effective, and much easier of application than tobacco or other established remedies, but requires to be so treated as to give out its ammonia in the form of a gas. A hole large enough to admit the pipe of a watering-pot is to be made near the bottom of one of the doors of the hot-house; a watering-pot, containing a quantity of ammonia water, is to be placed aslant, and to have its pipe inserted in this hole; a small quantity of turf, wood, or coal is to be kindled under the watering-pot; and the ammoniacal gas will become disengaged from the water, and diffuse itself through the house. If the quantity of gas introduced to the house do not exceed in volume one-fifth of the whole cubic space which the house comprises, it will inflict no injury on even the most delicate stove or conservatory plant, and, in less than fifteen minutes it will kill every plant-louse and every mealy bug within the walls; but at the end of fifteen minutes, it ought to be drawn off from the house by the opening of the ventilators; and if it be needed for the destruction of the scaly bug, it must be applied from the tube of a retort, or other fit vessel, to the part of the plant affected. Ammoniacal gas, it is obvious, might be used to destroy flies and moths in the farm-house; and ammonia water might be employed to sweep away a large proportion of vermin from the farmery. Among the most recent applications of ammonia is that for preventing incrustation on steam-boilers, first suggested by Dr. Ritterbandt, who uses the chloride of ammonium for this purpose. This substance does not discolour the water, nor communicate to it any unpleasant taste or smell; it has no injurious effect upon the metal of the boiler; it does not increase the density of the water, and therefore does not produce 'priming;' nor does its application involve any alteration in the boilers now in general use. The action of the chloride of ammonium is to change the carbonate of lime into chloride of calcium, which is not deposited by heat; and as the crystallization of other salts, such as the sulphate of lime, depends in a great measure upon contact, the absence of nuclei of solid carbonate prevents, in a great measure, their formation. In marine boilers this is very evident, for after adding chloride of ammonium, and thus preventing the precipitation of insoluble carbonate of lime, it is almost impossible to obtain crystals of common salt; thus 'blowing off' is rendered almost unnecessary.

Ammonia, in several forms and in numerous compounds, is somewhat extensively used in human medicine; but it is both sparingly and rather doubtfully used in veterinary practice. In the form of aromatic spirit of ammonia, in doses of from one ounce to two ounces, and in a simple menstruum of warm water, it has, in cases of flat-

ulent colic, been administered to horses, with decidedly good effect, and after other remedies had failed. In the form of hartshorn, it is an useful ingredient in some stimulating liniments, particularly such as are used for paralytic affections in cattle. In the form of carbonate, it has been much extolled as a specific for hoove in cattle; but, when tried in this capacity by Mr. Youatt, who always doubted its efficacy, it failed. "It was administered," says he, "as a chemical principle, it being supposed that the alkali would neutralize the acid gas that was extricated from the fermenting food; but it has been proved that this gas consists chiefly either of carburetted or sulphuretted hydrogen; besides which there is another consideration, that, except administered by means of Read's pump, not one drop of the ammonia would find its way into the paunch."—*Ure's Dictionary of Chemistry*.—*Liebig's Organic Chemistry*.—*Johnston's Lectures on Agricultural Chemistry*.—*Boussingault's Rural Economy*.—*Annales de Chimie et de Physique*.—*Quarterly Journal of Agriculture*.—*Journal of the Royal Agricultural Society*.—*Loudon's Gardener's Magazine*.—*Youatt on the Horse*.—*Youatt on Cattle*.

AMMONIACAL GAS, SALTS, &c. See AMMONIA.

AMOMUM. A genus of tender herbaceous plants, of the Ginger family. Seven species, all from Africa and the East Indies, have been introduced to the hothouses of Great Britain; and about thirteen other species are known to botanists. One of the species, *Amomum grana paradisi*, yields the grains-of-paradise of the shops; and several of the species are regarded in the east as antidotes to poison. We notice the genus principally on account of its being very generally confounded with the cardamom of the shops, which is really a species of alpinia; with ginger, which is itself a genus, comprising about sixteen species; and especially with a medicinal herb of the hedges and groves of England, popularly called bastard stone-parsley, growing to the height of three feet, and bearing seeds which have somewhat the smell of mace.

AMORPHA—popularly BASTARD INDIGO. A genus of North American deciduous shrubs, of the Pea tribe. Six species are known to botanists, and have all been introduced to Great Britain. The best known species, *Amorpha fruticosa*, was formerly used in Carolina as an indigo plant; and continues to be extensively cultivated in Britain as a hardy ornamental shrub. This plant possesses very considerable beauty, but is encumbered with some serious defects. Its foliage is not fully displayed till late in spring; and the ends of its branches are often destroyed, or otherwise permanently damaged, by frost. Its leaves are large, of a pleasant green colour, and beautifully pinnated, with folioles arranged in pairs, and an odd foliole at the end. Its flowers are purple in colour, and singular in structure; and they grow in spikes seven or eight inches in

length. The amorphia produces its best effect when planted in clusters or small groves, in a well-sheltered situation. This plant may be propagated either by layers or by seeds obtained from America.

AMPELOPSIS. A genus of ornamental climbing shrubs of the vine family. Four species have been introduced to Britain from North America; and two other species are known to botanists. Two of the species, the hairy and the virgin creeper, grow to the height of sixty feet. All the species closely resemble the vine in habit, leaves, and flowers; they grow with great rapidity; and they are used for covering old walls.

AMYGDALOID. A kind of trap rock. It consists of a greenstone or fine trap with small imbedded spheroids of other mineral matter, of the general form of almonds. It is a comparatively rare rock; and yields by disintegration the same sort of general soil as most varieties of greenstone, basalt, and olivine porphyry.

AMYGDALUS. See ALMOND.

AMYLENE. A farinaceous substance of a nature intermediate between starch and gum. It is soluble in boiling water; and yields by evaporation a pale, semi-transparent, brittle substance, which is insoluble in alcohol, but soluble to any extent in water at 144°, and soluble in ten times its weight of cold water. Starch, dissolved in twelve times its weight of water, and exposed to the air for two years in a shallow capsule, becomes a gray liquid, covered with mould, free from smell, and without action on vegetable blue colours; and an analysis of this liquid will show that one-fourth of the starch by weight has disappeared, and that the remainder has passed into amyline, gum, sugar, starchy lignine, and lignine mixed with charcoal,—the sugar alone amounting to one-half of the starch. The word *amyline* is sometimes, though incorrectly, used to express the sum of nutritious matter in albuminous vegetables; and the epithet amylaceous is often applied to the cereal grains and other plants which yield the fine flour from which starch can be made.

ANACARDIUM. See CASHEW NUT.

ANAGALLIS. See PIMPERNEL.

ANAGYRIS,—popularly BEAN-TREFOIL. A genus of tender evergreen shrubs, of the Pea tribe. The broad-leaved species grows ten feet high, and was introduced from Teneriffe in 1815; the Nepaul species grows eight feet high, and was introduced from Nepaul in 1821; and the fetid or stinking species grows nine feet high, and was introduced from Spain in 1570. The last has sported itself into several varieties, and acquired hardness of habit. Its leaves are hoary in all the varieties, but oblong and narrow in some, and oval and moderately broad in others; and its flowers are numerous, of a bright yellow colour, and produced from the sides of the branches like those of laburnum.

ANALOGY. A certain relation, correspondence, or agreement, between several things in

some respects, which yet differ in others. Or, in respect to the process of thought, that sort of reasoning by which we argue from known to unknown resemblances.

The second law of philosophizing laid down by Sir Isaac Newton, recommends drawing conclusions from analogy where the resemblance between the things compared is strong. "Of natural effects of the same kind," says that law, "the same causes are to be assigned as far as it can be done. As of respiration in a man and in a beast; of the descent of stones in Europe and in America; of light in a culinary fire and in the sun; and of the reflection of light in the various planets." Where the analogy is so very manifest as in the cases here adduced, the conclusion drawn from it approaches to absolute certainty; and, in many cases, we have no better way of reasoning from what is known to what is unknown. The arguments by which Sir Isaac Newton establishes the truth of the system of universal gravitation are precisely of this sort. He proves that the planets, in their deflections towards the sun, are all governed by the same analogy that is observable in the deflections of the earth towards the sun, and of the moon towards the earth, as well as of a body projected obliquely at the earth's surface towards its centre: whence he infers, with the force of demonstration, that all these deflections spring from the same cause, or are governed by one and the same law, to wit, the power of gravitation, by which a heavy body, when unsupported, naturally falls to the ground.

But there is a natural proneness in men to carry arguments drawn from analogy too far; so that this law of philosophizing requires to be interpreted with more strictness, and its abuses more carefully guarded against than any other. That principle of human thought by which we form numerous combinations among the objects of our knowledge, according to real or supposed resemblances, is continually prompting us to carry comparison farther than the nature of things will warrant. We are always apt to judge of things little known by those with which we are familiar; and to trace similitudes, which, though often the mere suggestions of our imagination, we are apt to mistake for discoveries of reason. Natural historians are fond of tracing an analogy between the three kingdoms of nature,—the animal, the vegetable, and the mineral. The analogy between animals and vegetables is doubtless, in many cases, very striking. They are both of an organized or vascular structure; both grow and expand from minute germs by assimilating nourishment from the different elements; both are capable of reproducing their kinds by the generation of ova or seeds. These, and various other points of analogy between plants and animals, are sufficiently striking, and have been admitted by all: see our article ANIMALS. But naturalists have not stopped here:

they have extended to vegetables properties which can only belong to sentient beings. It is thus that they have ascribed to plants, a state of sleep and of wakefulness, a power of voluntary motion, and a capacity of avoiding danger, till at length they have not hesitated to ascribe to them actual sensibility and perception, and have elevated them to the very rank of living creatures. "Trees," says Mr. White, "are animated; they have their food, their enjoyments, their grief, their health, their illness, their watching, their sleep, their emanations, their absorptions, their infancy, their growth, their puberty, their manhood, and their love. The man who does not find in animals younger brothers, and in plants cousins, more or less removed, is unacquainted with his own nature, and is devoid of the elements of morality." [*On the Gradations in Man*, p. 6.] This is a considerable stretch of analogy; but it is exceeded by that spirit of generalization which would ascribe life and sensibility to stones. "The vegetation of stones," says the bishop of Llandaff, "hath been admitted by many; and some have contended that minerals, as well as animals and vegetables, spring from seed; the greatest being nothing but the expansion of the parts of a minute grain of sand." "I do not know," adds he, "whether it would be a very extravagant conjecture, which should suppose that all matter is, or has been, organized, enlivened, and animated." [*Watson's Chemical Essays*, vol. v.]

We infer from analogy, with a high degree of probability, that the planets are peopled with inhabitants, on account of their numerous points of resemblance with our earth. They all revolve round the sun as the earth does, and are governed in their revolution by the same law of gravitation. They all, like the earth, borrow their light from the sun, and most of them are known to have a rotation on their axes; and therefore, like the earth, to have a vicissitude of day and night. Several of them likewise are attended by moons as the earth is. From these manifold points of resemblance, it is highly reasonable to conclude that these bodies are, like our earth, destined to be the habitation of various orders of living creatures. Such an argument, drawn from analogy, is perfectly legitimate, and carries with it the greatest probability. But who can help smiling at the extent to which the learned Wolfius carries this kind of analogical reasoning, when he proceeds upon it to calculate the precise dimensions of the supposed inhabitants of the different planets! [*Elem. Astron. Genev.* 1735, part 2d.] The inhabitants of Jupiter, he thinks, must be giants; and he grounds his opinion chiefly on the small degree of solar light which they enjoy; so that the pupils of their eyes, and consequently their whole bodies, must be considerably larger than ours.

Analogy between the whole animal kingdom and the whole vegetable kingdom, or between certain groups or species of animals and certain

groups or species of vegetables, has long been a favourite subject of theory on the part of many scientific writers, and a prolific source of bewilderment on the part of almost all their practical readers. Passion for theory, or the mere poetry of science, has generally occasioned inquirers to confound a few resemblances on the very outskirts of the two kingdoms, or a similarity between one or two phenomena of certain species, with a true and pervading analogy. The real analogies which exist, and which alone can give light to science or assistance to practice, seem to be too few and commonplace for the abstruse purposes of theorists; and the unreal analogies, which are suggested by resemblance or created by fancy, appear to possess an absurd charm in their very incomprehensibility by plain men, and total want of all possible adaptation to any purpose of utility. Any of our practical readers who cannot understand the analogies between a buffalo and an oak-tree, between a snail and a hyacinth, between a sheep and a rose-bush, or between a jelly-fish and a bean-plant, may assure himself that he will suffer no detriment from his ignorance.

All animals and all vegetables possess life; all have organization; all elaborate great chemical changes in their interior organism; most grow or enlarge their substance by assimilating alimentary matters obtained from without; many, perhaps most, throw off, in an excrementitious manner, such proximate elements as are unsuited to their own substance; most vegetables and nearly all animals, propagate their respective species by fecundation; the epitome of any phænogamous plant, when buried as a seed in the soil, rots and reproduces the whole plant, and the epitome of the human body, when buried in its final terrestrial form in the earth, rots and will eventually rise again in glory;—these are true analogies, and they afford exquisite mutual illustrations of the constitution of the two great classes of organized bodies. But they are not at all the kind of analogies with which imaginative physiologists have wished to entertain their readers.

One favourite analogy with theorists is between the circulation of the sap in plants and the circulation of blood in animals. But this is a mere play upon a word. The motion of liquid within a plant is simply the ascent of sap and the descent of cambium,—the free ascent of the liquid in one form, and the fixational descent of it in another form. We speak of the circulation of moisture in the soil, when we mean merely the descent of rain-water and the ascent of aqueous vapour; and we speak, in a precisely analogous manner, of the circulation of sap in plants; but we do not imagine, for a moment, that these are true circulations; nor ought we, for an instant, to compare them with the constant circulating flow of the slowly changing vital blood in an animal. Yet a highly distinguished phytologist of

the present day assumes, first, that the ascent of sap and the descent of cambium are the same phenomenon as the circulation of blood,—next, that the flow of the sap and the cambium forms all organs and wields the power of all organic functions,—next, that sap constantly rises by capillary attraction, when any proper force is at work for removing obstructions from the top of the capillary tubes,—and next, that a precisely proper force of this kind is in constant action in the chemical play which goes on within the leaf;—and on this most unphilosophical series of assumptions, all based on the fancied analogy between vegetable and animal circulation, he erects the monstrous doctrine, that life is a chimera of the dark ages, and that what we usually designate life is only a combination of capillary attraction and simple chemical action! How dismally and most humbly true does it continue to be, that “the world by wisdom knows not God!”

Another favourite analogy is between the alleged respiration of plants and the true respiration of animals, or between the functions of leaves and the functions of lungs. But the leaves of plants elaborate the sap brought up to them from the roots, and bring a portion of it into a condition of fitness to be incorporated with the plant's substance; and, in this office, they are vastly more analogous to a stomach than to lungs;—and in so far as they operate with atmospheric air, they in fact achieve the very reverse of the result which is worked out by the lungs of animals; for they take in the carbonic acid of the atmosphere, abstract its carbon, and give back its oxygen; while animal lungs take in the oxygen of the atmosphere, combine it with liberated carbon from the blood, and give back carbonic acid to the atmosphere; and indeed these reverse and entirely unanalogous processes constitute the principal and most beautiful contrivance by which the wisdom of the all-beneficent Deity preserves unimpaired the purity of our atmosphere, and maintains the balance of animal and vegetable forces in our world. The fact that both leaves and lungs operate on atmospheric air, is no more a ground of analogy, than the fact that all substances in the processes of oxidation, combustion, fermentation, and putrefaction also operate upon atmospheric air. A stagnant pond or a fen, in particular, might, with far more truth than leaves, be alleged to breathe; for it does exactly that to atmospheric air which is done to it by animal respiration.

The two examples which we have stated sufficiently illustrate the fallaciousness of the analogies which are commonly instituted between the functions of plants and the functions of animals; and a very brief example or two may equally exhibit the character of those which are commonly instituted between the organic structure or the entire economy of the two kingdoms.—One analogy is instituted between seeds which are long in a dry condition, and afterwards germinate

when placed in moderately moist soil in the open air, and the animalcules called *anguillæ* and *rotiferi* which may be dried into an inert and seemingly lifeless condition, and will revive in a brief period after being immersed in water. But the seed is only the small and final epitome of the plant, and not the plant itself; and it is never out of its natural condition, but passes through a proper stage of its existence in drying and lying temporarily dormant as truly as it did in ripening; while the *anguilla*, or the *rotifer*, is the entire animalcule, and is first placed in an unnatural condition, and afterwards restored to its native element. The supposed analogy, therefore, is a mere fancy; and even were it a fact, it applies to but a speck of the extreme verge of the animal kingdom, and cannot, without the most violent outrage, be regarded otherwise than as a perfect contrast to the general and pervading law of that kingdom; for animal organization, with scarcely any other exception than this trivial one among animalcules, is absolutely and broadly distinguished by tendency to rapid decomposition.—Another favourite analogy is between the reproduction of plants by slips or cuttings, and the reproduction of polypi by simple division or cutting asunder. But this, too, might easily be shown to be more apparent than real; and even though admitted to be a fact, is strictly an anomaly and not an analogy; for cutting asunder can as little illustrate as it can effect the reproduction of almost any other form of animated body than the polypus.

A kind of analogy in newer vogue asserts that a plant is not a plant at all, but a commonwealth of plants,—its leaves, flowers, stipules, spikes, and other parts being so many individuals of different ranks, living together in the same fashion as magistrates, merchants, farmers, and operatives in a nation of human beings; alleges that individuals of one rank in this commonwealth are convertible into individuals of another rank, the leaves for example into flowers, or the spikes or roots into branches; and tells us that certain zoophytes or plant-like animals, called *sertulariadae* also grow and stick together in the manner of commonwealths, and that the nutritive individuals of each mass or commonwealth of them are convertible into reproductive individuals, and the reproductive individuals into nutritive. One of two things which this theory takes for granted, that a corn-plant or a cabbage is not an individual plant but a whole commonwealth of corn-plants or of cabbages, is every way worthy of the derision with which all ploughmen and ditchers are certain to treat it; and the other thing taken for granted, that the different parts of plants are convertible into each other, though undoubtedly countenanced by many interesting facts, is not wholly true,—but will fall to be briefly noticed in our article on MORPHOLOGY. Yet though the assumptions were conceded, the alleged analogy

founded on them, like the two preceding alleged analogies, applies to a mere speck on the frontier of the animal kingdom, and, as regards the rest of that kingdom, is a downright anomaly and contrast.

Another new set of alleged analogies is eloquently advocated by Professor Forbes, and is stated, in the following terms, in a report of a paper which he read at a meeting of the Royal Institution: “If we regard the animal and vegetable kingdoms as consisting of two spheres or groups, we should find that there was a parallelism existing between these groups in their subordinate members. One singular fact he would remark with regard to the representation of numbers in certain parallel groups of animals. It was well known that the jelly-fishes (*Acalephæ*) had their parts arranged upon the number four, whilst the star-fishes (*Echinodermata*) assumed the number five; but whenever any abnormal forms of these animals were met with, then it was found that the jelly-fishes assumed the number five, and star-fishes the number four. The two spheres or groups of the animal and vegetable kingdom he called *concentrate* and *articulate*. The concentrate was characterized by a tendency to concentration, to the formation of an internal skeleton, and a unity of combination. The articulate was characterized by its tendency to elongation, the formation of an external skeleton and articulation. In the application of this theory to the highest groups of the animal kingdom, the *Vertebrata* belonged to the concentrate sphere, and the *Invertebrata* to the articulate sphere. In the vegetable kingdom, the *Exogens* represented the concentrate sphere, and the *Endogens* the articulate sphere. In descending to groups of less value, the same opposition of the spheres in parallel groups might be observed as in the *Amorphozoa*, which represented the concentrate sphere, and the *Echinodermata* the articulate sphere in the animal kingdom. In groups of ordinal value, the two great orders of fishes might be given—the osseous fishes representing the concentrate, and the cartilaginous fishes the articulate spheres. As an illustration from the vegetable kingdom, the *Rosaceæ* and *Leguminosæ* might be taken. The former exhibited the concentration and other properties of the concentrate spheres, as seen in their fruit; whilst the latter exhibited a tendency to elongation, the formation of an external skeleton and articulation, as in the articulate sphere. This representation of the spheres was also evident in genera and even species.” How a rose-hip resembles a horse and other animals which have a backbone and ribs, and how a pea-pod resembles a slug, an oyster, a medusa, and other animals which have no backbones or ribs, we confess ourselves too obtuse to understand; but even though the resemblance were quite perceptible, it refers to but the seed of plants and to the whole body of animals, and seems fitted to throw utter obscurity over all our best notices

of organized being, without imparting one ray of compensating illustration.

But analogy has, by some phytologists, been restricted wholly to resemblances amongst plants themselves, and distinguished from what they call *affinity*. Analogy, according to this class of theorists, is a correspondence between certain parts of two groups of plants, which differ in general structure and belong to different series; while affinity is a correspondence of individual structures of any one group or series. Thus, the correspondencies between Acrita and Protophyta constitute an analogy; and those between any two species of Acrita or any two species of Protophyta constitute an affinity. But, though these distinctions have been magnified by one or two writers into great importance, "they do not"—to adopt the words of Professor Lindley—"appear to possess the value that is attached to them, as cases must be continually occurring in which the terms are convertible,—thus, the genera Berberis and Bocagea are in analogy if considered with reference to Berberideæ and Annonaceæ, but in affinity if viewed as a part of Thalamifloræ."

ANALYSIS. The reduction or separation of compounds into their component ingredients. The word is applied, in a logical sense, to the reduction of complex arguments and intricate reasonings to their several premises and propositions; in a metaphysical sense, to the reduction of compound ideas, involved thoughts, and even the mental powers themselves, to their constituent parts or their several phases; in a mechanical sense, to the separation by force of mineral or vegetable mixtures into their several ingredients; and in a chemical sense, to the reduction of a compound substance, whether animal, vegetable, or mineral, by means of heat, electricity, decomposition, and recombinations, or generally by means of what are termed chemical affinities, into either less compound substances or its absolute elements. Logical and metaphysical analyses are quite beyond the sphere of the farmer; but both mechanical and chemical analyses are of exceedingly high value to him for the testing of ashes, animal manures, vegetable composts, and especially soils. Mechanical analysis always brings the ingredients of a mixture into a state of separation from one another; but it rarely reduces them to their elements, or is capable of reducing any compactly compound substance; and it is effected by bruising, sifting, washing, filtering, weighing, and similar gentle and wily applications of force. Chemical analysis encounters every kind of compound substance from a commingled gas to a metalliferous rock, and from the leaf or the sap of a tree, to the bone or the secretions of an animal; it sometimes brings the ingredients or elements into a severally separate condition, but much more frequently reduces and ascertains them by causing them to enter into new combinations; and it usually achieves its

results by means of a number of simple substances, in a state of great purity, of well-known and thoroughly established chemical affinity, and usually designated *chemical reagents*. The analysis of soils and manures is of prime value in agriculture, and ought to be well understood by every farmer who makes pretensions to even a moderate scientific knowledge of the principles of his art. The apparatus for performing it is neither costly nor very complex; it consists principally of a balance, a set of weights, a compound or serial sieve, an argand lamp and stand, some glass bottles, some fire-proof crucibles, some evaporating basins, two or three filters, a series of vessels for collecting and measuring gases, one or two retorts, and small quantities of a few chemical reagents; and it ought to find a place in a small room or laboratory of every home-farm, every model-farm, and every ordinary farm of any considerable extent. Or when the entire apparatus is, in any instance, thought too complicated for the scale of the farm or the means or leisure of the farmer, at least the portion of it required for mechanical analysis ought to be provided and to be in frequent requisition. But as the constituents of soils, manures, and subsoils require to be well understood before any judicious analysis of them can be attempted, we reserve a detail of principles and processes to the article SOILS (ANALYSIS OF); and shall here insert a general outline of the principles of chemical analysis.

Chemical analysis embraces two distinct parts: 1st, to find the different ingredients of which a substance is composed; and, 2d, to determine the quantity in which they exist in it. The former is designated by the name of *qualitative analysis*, and must always precede the latter, which is termed *quantitative analysis*. As matter cannot be destroyed, the weight of all the component parts must equal the weight of the whole body. If the latter, therefore, be the result of the quantitative analysis, it confirms greatly the correctness of the qualitative analysis that no ingredient has escaped our notice; but not absolutely so, since two or more ingredients resembling each other, and following together in the quantitative estimation, may have been mistaken for one; while, on the other hand, if the joint weight of all the component parts do not equal that of the whole body, and this deficiency cannot be accounted for by any imperfection in the methods employed, it proves conclusively that some ingredient has escaped our notice.

To analyze a substance, does not necessarily imply the separation of the substance into its component parts, so as to have them all in a perfectly free state; for some of them would be found endowed with such powerful affinities, that it would be a matter of extreme difficulty to obtain them in their free state, and still more difficult, if not impossible, to retain them so. In most cases, therefore, we merely transfer the component parts of the substance under analysis to

combinations, the nature and composition of which are well known.

The reverse process of analysis is *synthesis*, by which we again produce a substance from its component parts. But as certain substances often combine only under peculiar circumstances, it will be evident that, unless we know these circumstances, or are able to contrive them, the synthesis of the substance under such circumstances will remain impracticable, but does not, therefore, in the slightest degree, impair the correctness of our analysis.

Chemical analysis requires, more than any other branch of applied chemistry, a thorough knowledge of the science of chemistry; but it is, on the other hand, itself the base of all chemical knowledge, since it alone enables us to investigate the changes which take place whenever chemical affinity is called into action, and to ascertain the laws which govern them, by ascertaining the exact composition of the resulting compounds. The progress of the science of chemistry, and the perfection of analytical chemistry, have, therefore, always kept pace with each other. The following are the general principles of chemical analysis. A substance is either a simple body, an element, or a chemical combination, or a mechanical mixture of them. An example will illustrate this. Hydrogen and chlorine gases are both elementary bodies, viz. such as chemistry is not capable of further separating into others, but which may be recovered again from all combinations in which they exist. If these be mixed in equal volumes, we have a mechanical mixture of two elementary bodies, which again may be separated without the aid of chemical means, as by mere absorbents. But if the mixture be exposed to the sun's rays, they suddenly enter into chemical combination, which is made apparent by a flash of fire passing through the whole mass. The gas suffers hereby no change in volume nor in weight, but, on examination, it will be found to have entirely different properties from either hydrogen or chlorine, or their mixture; it is an entirely different gas, called chlorohydric acid gas, from which neither of its constituent elements can be separated by any merely mechanical means. If any of the two gases were added in a larger proportion than equal volumes, we should still have the same occurrence, but instead of the whole of the gas being converted into chlorohydric acid gas, we should have this latter gas, mechanically mixed with the gas added in excess, or a mechanical mixture of a chemical compound with an element.

A *mechanical mixture* may often be separated by mere mechanical means into its component parts, which may then be recognised as substances of known chemical composition. Thus, a mixture of a light and a heavy powder may often be separated by washing with water, which will float off the lighter. Although, in such cases, where we employ purely mechanical means to

separate mixtures into their component parts, the operation ought strictly not to be called *analysis*, at least not *chemical analysis*; still ordinary language does not draw this distinction principally where the quantitative estimation of any of the component parts is the main object. We might thus speak of the analysis of a magnetic iron ore, when it is pulverized, and the ore separated from the gangue by extraction with a magnet, in order to determine their relative quantity. The modern improvements in the microscope, and its use, afford to chemistry an invaluable means of discovering component parts, where they exist merely as mechanical admixtures, when chemistry alone would be unable to decide it. Thus, the long-contested question among chemists, whether kermes mineral contained oxide of antimony, as an essential or chemically combined part, was decided by the aid of the microscope, by showing the oxide of antimony to exist in it in the state of exceedingly minute crystals, and therefore not in chemical combination with the sulphuret of antimony. Mechanical mixtures may further be separated by mere absorbents or perfectly neutral solvents, which take up some of its parts and leave others behind; and if, on the other hand, a substance be taken up from a mixture by a solvent, to which it otherwise is perfectly indifferent, or has no chemical affinity, there is good reason to believe that it existed merely as mechanical admixture. Or some or all the ingredients may be taken up by a solvent and afterwards separated by crystallization, or by precipitation, by the addition of other perfectly neutral solvents to the first.

Mechanical mixtures may also be analyzed by more purely chemical means, such as dissolving reagents, if some of the admixtures be acted on by them, while others are not affected. If we thus treat a mixture of carbonate of lime and silica with a dilute acid, the latter dissolves the lime, with expulsion of the carbonic acid, while insoluble silica is left behind. A very considerable number of what are commonly called *chemical analyses* are nothing more than the separation of mechanical mixtures by the two last-mentioned means: thus, a great many analyses of parts of plants or animals, by which they are separated by different solvents into different neutral substances, such as sugar, starch, gum, lignin, volatile oil, &c., are nothing more than a separation of a mechanical mixture of these substances. Heat and other such agents may also be often used for the same purpose: thus, mixtures of different fatty matters of different fusibility, may be separated by cautious fusion; or liquors of different volatility by distillation. It is mostly in analysis for scientific purposes that it is of importance to ascertain whether a substance is a pure chemical combination or a mechanical mixture of several compounds. For most practical purposes the main object is merely to find the ingredients, it being of little or no

interest whether these are in chemical combination or merely mixed together. If, therefore, inspection does not lead to distinguish the ingredients, their separation is effected as if it were a chemical combination, without reference to its mixed nature.

It has already been stated that all substances are either elementary bodies or their chemical combinations, or mechanical mixtures of both. Those substances which chemistry is not capable of separating into others, it calls elementary bodies, and then proves all the rest to be formed by their union or combination. Two elements form, by their union, binary combinations, but when these again combine, the result is a more compound body, containing three or more elements. On the other hand, most of the more compound bodies may again be separated into binary, or at least less compound bodies. These latter are then said to be the *proximate constituents* of the more compound body; while the elementary bodies into which it is finally resolved are called its *ultimate constituents* or *elements*. Thus, oxygen combines with sulphur, forming sulphuric acid, and with potassium, forming oxide of potassium or potash; but sulphuric acid combines again with potash, and forms sulphate of potash. Oxygen, sulphur, and potassium, are then said to be the ultimate constituents or elements of sulphate of potash, while sulphuric acid and potash are its proximate constituents. When the proximate constituents of a substance are known, we may generally infer from them the ultimate constituents; and, *vice versa*, if the ultimate elements are known, theoretical chemistry will generally teach us which are the proximate constituents. Analysis may, therefore, in more compound bodies, discover and determine either the proximate constituents, or the elements. This is altogether accidental, and depends on the peculiar method adopted, or on the facility with which either the proximate constituents or the elements are detected and estimated. Thus, for instance, if the above substance, sulphate of potash, were unknown to us, and therefore subjected to analysis, whether we should first discover the sulphur or the sulphuric acid, would probably depend on the method adopted. If we first examine it by the blowpipe, the sulphur would probably be first made apparent; while, if we first tested it in the moist way, we should recognise the sulphuric acid. In the same manner, in determining the relative quantity of the constituents, we should neither estimate directly the quantity of sulphur by itself, nor that of the sulphuric acid, but transfer them both to a combination, from the quantity of which, either that of the sulphur or of the sulphuric acid may be calculated with equal facility. It is therefore indifferent of itself, whether we give the result of the analysis in so many parts of sulphur, oxygen, and potassium, or so many parts of sulphuric acid and potash. Convenience and custom,

or theoretical notions, decide here, as in other matters.

In regard to the analysis of *chemical combinations*, it may be remarked that, as it is a necessary consequence of chemical combination that the constituents, either ultimate or proximate, which enter into combination, necessarily alter more or less their original nature and properties, none of the constituents of an unknown chemical combination can be recognised with certainty in it from its nature and properties. It will therefore be seen, that in order to find what constituents it is composed of, it becomes necessary to overcome the affinities by which the latter are held in combination, so as either to set them free and make them appear with their original properties, by which they may be recognised, or to transfer them to other combinations, which are either known or may be recognised. It would thus be impossible to recognise hydrogen or chlorine in chlorohydric acid gas; nothing could be more totally different from either of its constituents. But, if we introduce a piece of metallic zinc into the gas, the affinity of the zinc to the chlorine will overcome the affinity of chlorine to hydrogen. The chlorine will therefore be taken up by the zinc, and leave the hydrogen in its free state, which can then be recognised by its usual properties.

Another mean which analytical chemistry employs for overcoming existing affinities and setting the ingredients free, or transferring them to other combinations, is heat, which often will induce the gaseous elements to separate and assume their free state. Oxide of mercury may thus be separated into its two elements, oxygen gas and metallic mercury. Carbonate of lime is separated by ignition into carbonic acid gas and lime. Volatile liquids and solids may also be expelled by heat from their combinations, by their tendency to assume the gaseous state at higher temperatures. Thus, chemically combined water is generally discovered by heating the substance in the closed end of a glass tube, when it will be expelled, and condense in the colder part of the tube.

Electricity is another agency for overcoming affinity. It was by this agency that Sir Humphrey Davy discovered the metallic radicals, and the compound nature of the alkalis.

But the mean most often made use of in analyses of substances is chemical affinity itself, either single or double elective affinity. In the former case we have a combination of two constituents, and present to it a third substance, for which one of the constituents has a greater affinity than for the other, and therefore leaves the latter in its free state, and combines with the substance added. Thus, if uric acid be in a solution, combined with a base, and a stronger acid be added, to which the base has a greater affinity, it will combine with the latter, and leave the uric acid, which thereby is separated in its free state, as

an insoluble powder; or if sulphuric acid be added to a solution containing baryta, the affinity of the latter for sulphuric acid is greater than for any other acid. It will therefore combine with it, and separate as an insoluble and easily recognisable compound, sulphate of baryta. What single affinity is unable to effect, may be accomplished by double affinity. Thus, if oxalate of lime were given us for analysis, we should not be able to separate the oxalic acid from the lime by any acid or base alone; but if we treat it with carbonate of potash, the affinity of the potash for the oxalic acid, and that of the carbonic acid for the lime, act at the same time, and we decompose it into oxalate of potash and carbonate of lime, in which compounds the oxalic acid and the lime are easily detected.

When thus liberated, or transferred to other combinations, we employ various means to recognise the ingredients, or the new compounds to which they are transferred, as their physical properties, such as peculiar or striking colours; thus, the presence of manganese in a substance, is recognised by the green colour which it yields, when fused with nitre and carbonate of soda, owing to a combination, which it always forms under these circumstances. Another means of recognition is by their peculiar odour or taste; thus, acetic acid, when liberated, is, in most cases, recognised by its peculiar odour, and the different kinds of sugar by their taste. The senses of smelling and tasting are of no less importance to the analytical chemist than the sight, and are capable of considerable cultivation. It is particularly in organic analysis that they are invaluable, as affording the only means of discovering many of the organic proximate constituents. Of no less importance are the different forms of aggregation, which the ingredients or their new combinations assume: as, for instance, whether they appear as a gas or a liquid, or an insoluble solid. This latter is of particular importance, and we therefore generally try to effect a solution of the substance, and then add different other substances, mostly in solution, with which the different ingredients form compounds, which separate, and are distinguished by their different degrees of insolubility, or peculiar form of aggregation, such as whether they be heavy or light, pulverulent, flocculent, crystalline, &c.

The substances we add for the sake of separating or combining with the ingredients of the substance under examination, are called *reagents*. If they produce any change with them, they are said to react with them; if they form insoluble compounds, which separate, they *precipitate* them; if the produced change or compound be such as to lead to the recognition of the ingredient, it is said to be a *test* for it. Thus, when a solution of iodine is added to a solution containing starch, it produces a beautiful blue colour. As iodine produces this colour with no other substance than starch, we say that iodine is a test for starch.

Or if we add a solution of a salt of baryta to a solution containing sulphuric acid, the latter precipitates in combination with baryta, as sulphate of baryta, which remains insoluble by the addition of chlorohydric acid. As no other substance forms a similar precipitate with barytic salts, insoluble in water and an excess of chlorohydric acid, baryta is said to be a test for sulphuric acid. The insolubility of the compounds formed by the addition of reagents with the different ingredients, becomes of still more importance, since it affords the means of removing them, either for the sake of further examining them, or of preventing them from interfering, by their presence, with the discovery and recognition of the other ingredients.

In this way, all the different ingredients of a substance, may be recognised by adding the different reagents and tests to different portions of the substance or by applying them successively to the same portion, removing, if necessary, the ingredients, as they are recognised. But, by such indiscriminate or random application of reagents it would not be possible to prevent some ingredients from escaping notice. It therefore becomes necessary to introduce a systematic method of proceeding in the application of the reagents. As the reagents, for their action, always require more or less fluidity, this may either be attained by heat or fusion, or by solution. Hence, the distinction between *analysis in the dry*, and *in the moist or humid way*. The qualitative examination by the former method is generally performed more or less in connection with the blowpipe, by which we fuse small beads of different substances, and then observe the reactions which take place by adding small portions of the substance under examination, and its behaviour by different treatments, and with different reagents. For some metallurgic purposes, fusion on larger scale in crucibles, by the aid of furnaces, is resorted to; but although testing, in the dry way, and by the blowpipe in particular, has been carried to a high degree of perfection, and is performed with a great deal of facility and convenience, it cannot compare, in point of completeness or systematic procedure, with that in the moist way.

By testing in the moist way, it always becomes an object to effect a solution of the substance, and then apply such reagents as will form insoluble compounds with a certain class or group of ingredients; then separate these, and apply another reagent, which will separate another class or group of ingredients, left in solution by the previous reagent, and so on: thus, all known ingredients are separated into groups, containing only a certain number of them, which are themselves distinguished or separated from each other by other reagents and tests. The last class or group is formed by those ingredients which are not precipitated by any of the previously applied reagents, and it being known which such may

be, their presence or absence may be ascertained by special tests for this purpose. The reagents which we thus most commonly make use of, are sulphuretted hydrogen and sulphohydrate of ammonium, to separate the metals proper; ammonia for the earths; the alkaline carbonates for the earthy alkalines, and the last class is generally formed by the alkalies. The electro-negative elements and acids are mostly detected by tests applied for their special detection.

In this way, with some practice, a tolerable certainty may be obtained, that no ingredient has escaped our notice, which is still more confirmed by the subsequent quantitative analysis, when the joint weight of them all is found to equal that of the whole substance. But before proceeding to the quantitative estimation, it is generally necessary to confirm and verify the conclusions which we have drawn from the regular systematic course of our examination, as to the presence or absence of the different ingredients, either by the application of other characteristic tests for those we have discovered, or by varying our method of examination, by which we might have been led into doubts or errors about others. Such confirmatory experiments or tests ought never to be omitted; and in the manuals of analytical chemistry, a large proportion of their contents is generally devoted to the behaviour of the different substances with most of the usually employed reagents, the greater portion of which will be found in the present work, under the heads of the different substances.

The elementary bodies themselves, when they occur as objects for analysis in their uncombined state, are recognised by their physical properties and their behaviour to the different reagents, by which they are made to dissolve and enter into combinations, and may then be recognised as other ingredients.

After having determined what the ingredients are, of which a substance consists, it next remains to estimate their quantity. For this purpose one or more portions of the substance are employed, and the weight of the different ingredients obtained from them ascertained, and generally expressed in 100 parts or per cent. of the substance. The object of quantitative analysis is, therefore, to liberate the ingredients in such a state, or to transfer them to such combinations, that a complete separation of them or their new combinations may be effected, and the estimation of their quantity become possible.

The quantitative analysis—or, at least, the quantitative estimation of certain ingredients—is sometimes performed in the dry way, and is then termed the dry assay, or, simply, assaying. Thus, for many metallurgic operations, the ores are fused in a crucible, with certain reducing reagents and fluxes, by the draft of a furnace or in the blast of a forge, and the quantity of reduced metal obtained from the ore ascertained. But, although these operations are not without prac-

tical value, still they are at present performed equally well, and with much more accuracy, in the moist way. The estimation of the quantity of gold and silver in alloys, by *cupellation*, is another much-practised application of the dry assay; but even here it may be substituted, and with still greater accuracy, by the moist way; and this latter is always resorted to whenever it becomes desirable to estimate the quantity of all the different ingredients which a substance contains.

It has been stated before, that chemical combinations have always the same composition. It is, therefore, not necessary that the ingredients should be weighed by themselves. Chemistry teaches us that when substances combine chemically, it is in certain fixed proportions, and that, therefore, pure chemical compounds always contain the same amount of their different constituents. When we, therefore, have separated an ingredient by transferring it to another chemical combination, it is only necessary to ascertain the quantity of this compound, and then, from its known composition, calculate the quantity of the ingredient, whose weight of the original substance we desired to know: thus, if a substance contain sulphuric acid, it would be impossible to separate the acid completely by itself, or weigh it, in this state; but if any other solution, containing baryta, be added, all the sulphuric acid will combine with so much of the baryta as is necessary to form an insoluble compound, the sulphate of baryta, which is easily separated and weighed, and from the weight of which the weight of the sulphuric acid is calculated. It is also evident, that instead of ascertaining directly the weight of an ingredient or its new compound, the loss in weight which they cause in the remainder, by their separation or escape, may be ascertained. This is the case, where the separation is easily effected; but the state in which it separates either renders it unfit for weighing, or its collection or preparation for this purpose is rendered more difficult than the weighing of the remaining substances: thus, oxide of lead combines chemically with water: by heating this compound the water is expelled as vapour. It is hence easier to weigh the oxide of lead subsequently to the expulsion of the water, than to condense the vapours completely, for the purpose of weighing them directly; but if the oxide of lead be, at the same time, combined with other volatile ingredients, as, for instance, in common white lead, which is a combination of oxide of lead with carbonic acid and water, it then becomes necessary to condense and collect the volatilized water, and ascertain its weight directly. Having then ascertained the loss of all the volatile matter and the weight of the condensed water, by subtracting the latter from the former, we obtain the loss or weight of the carbonic acid.

It often happens that two or more ingredients are easily separated together from the rest, but

their separation from each other cannot be effected at all, or but with difficulty. In such cases, their joint weight, or that of the combination in which they are separated, is ascertained, and then different methods resorted to for determining their relative quantity, as, for instance, from their different *physical properties*. This is often resorted to in practical life, where, in mixtures of only certain substances, the value depends on their relative quantity. The specific gravity of such mixtures affords, in many cases, a mean of determining their relative quantity, which is often made use of, particularly where one of the substances is water. Alcoholometry, or the method of determining the quantity of alcohol, in mixtures of alcohol and water, depends entirely on the difference of their specific gravity. All the various uses of hydrometers, for ascertaining the strength of substances, depend on the same principle. As soon, therefore, as other substances are added, besides those for which it was constructed, it ceases to be applicable to this purpose. The richness of many ores may be determined approximately by their specific gravity. Besides specific gravity, other physical properties may be employed, as different fusibilities; thus, the relative quantity of two different fatty matters has been determined from the point of fusion of their mixture. Other methods are derived from their relation to light or heat; thus, in mixtures of chloride of sodium and potassium, their relative quantity has been ascertained by the degree of cold which they produce by dissolving them in water.

In cases where two such substances have strong chemical, but similar affinities, and, therefore, are difficult to separate, but their combining weights are different, another method is frequently made use of in analytical chemistry, for which the rather improper name of *indirect analysis* has been proposed by Poggendorff. This method consists in separating them both together, by combining them with a third substance, and ascertaining the weight of this combination accurately; we then determine, in any other analytical way, the quantity of this third substance, which, subtracted from the former weight of their combination with it, gives the quantity of the mixture of them both; calculating, then, from their respective combining weights, the quantity which this third substance would have yielded with either of them alone, we are able to calculate, from the quantity actually obtained, the relative quantity in which they exist.

In some cases, where we are unable to separate an ingredient in any state or combination suitable for the estimation of its quantity, this can only be obtained by estimating the weight, successively, of all the other ingredients, and subtracting the joint weight of these from the weight of the whole substance; but it is evident that, in this case, any inaccuracy in the estimation of the other ingredients will fall upon it.

The preparation of a substance for analysis, and the subsequent separation of the ingredients, either for their recognition, or, more particularly, for their quantitative estimation, requires many mechanical operations and manipulations, such as pulverization, solution, precipitation, pouring, washing, filtration, ignition, weighing, &c., the perfect performance of which is of the greatest importance to the success of the analysis, but is often very tedious, and can only be learned by practice in a laboratory; yet a thorough knowledge of the principles on which they depend, will highly facilitate their acquisition. They are the rudiments of analytical chemistry, on which its performance depends; but as they often seem of a trifling nature, it requires some exertion of mind to submit to the drudgery of acquiring them. As analytical chemistry is the base of all chemical investigation, the want of them forms a great obstacle to the pursuit of chemistry, and they should therefore be early attended to. The spilling of a drop in pouring, or the spirting during evaporation, will often spoil long-anticipated results, and a single moment's inattention be the cause of losing weeks of labour, at a point when the result was nearly within grasp. The inability or unwillingness to go through the laborious and tedious process of an analysis, or to repeat it when unsuccessful, is also a continual temptation to scientific mendacity, by anticipating and pronouncing analytical results which have never been obtained. But truth cannot be obtained without labour, and is inseparably connected with honesty; and although a false ambition may thereby obtain, temporarily, a desired object, merited discredit usually returns, in the end, upon its originator. As a rule, no results should ever be admitted in science, unless accompanied by the details of the experiments from which they are derived.

Notwithstanding the perfection of the methods and the utmost care, some small loss of the ingredients in the different operations of quantitative analysis cannot be avoided. In well-performed analyses, of ordinary difficulty, this ought not to exceed one per cent., and in most cases be less. Beginners are apt to obtain more than the true weight, which arises from imperfect washing of the precipitates, or from hygroscopic moisture, attracted during the weighing, &c. In analysis, for practical purposes, the loss or excess is often distributed proportionally on all the ingredients, so as to make up exactly 100 parts; but in all scientific investigations, it is an established principle to give the results exactly as they are obtained.

As all chemical compounds are formed by the combination of their ingredients, in certain and fixed proportions, which are multiples of their atomic weights, it becomes a strong proof of the correctness of our analysis of a pure chemical compound, if the percentic composition correspond with multiples of the atomic weights; and

again, if the percentic weights of the different ingredients be simple multiples of their atomic weights, it affords a strong probability that the substance analyzed is no mechanical mixture but a true chemical compound. It therefore becomes desirable to find the number of atoms which corresponds to the percentage result of our analysis, and therefrom, if possible, to establish a chemical formula. This is done by dividing the percentage numbers by the atomic weights of the respective ingredients. The numbers thus obtained, express the relative number of atoms of the different ingredients; and in order to reduce them to small, and, if possible, whole numbers, the smallest may be made unity, and divided respectively into all the rest. How the number of atoms thus found is to be distributed, for the purpose of bringing it into a formula, in conformity with other similar combinations, depends entirely on theoretical views.

In regard to the history of analytical chemistry, its progress has, as might be supposed, been inseparably connected with that of the science of chemistry itself. Bergman, Scheele, Klaproth, and others, improved the analytical methods considerably, but it was only after the development, by Richter, of the doctrine of the fixed proportions in which substances combine, that it was elevated to the rank of a science. It is, in a great measure, to the unremitting labours of Berzelius, and his accurate determination of the fundamental or combining numbers, that it is indebted to its present perfection. The ultimate analysis of organic bodies is also indebted, for its present perfection, to the improvements of Liebig and several others.

ANASTATICA,—popularly *Rose of Jericho*. A small, perennial, hardy herbaceous plant, of the cruciferous order, from the Levant. It grows to the height of only six inches, divides into many irregular branches near the root, sends out from each joint a single, oblong, hoary leaf; and produces from June to August small, single, whitish-green, cruciferous flowers. This plant, after being gathered and thoroughly dried, has the curious property of recovering its original form upon immersion in water. It was superstitiously believed by the monks of the dark ages to open its flowers in the anniversary of the night of our Lord's incarnation, and in consequence was called by them *Rosa Mariæ*; and it is still superstitiously believed by many of the lower orders in Great Britain to possess the property, if placed in water at the time when a woman's labour commences, of expanding at the precise moment of her giving birth to her infant. It grows wild in the sandy deserts of Arabia and Palestine; and is there designated by a name which signifies 'Mary's hand.'

ANATOMY OF ANIMALS. The study of the structure, composition, mutual connection, and respective situation of the members and organs of animals, by means of the dissection of their

carcass, and the ocular examination of cuts and openings made by the knife. The anatomical structure of the principal domesticated animals, and an outline of the anatomical structure of man, are taught in veterinary schools; and a knowledge of both, particularly as illustrating each other, is of much value to the farmer, in regulating his treatment of the numerous domestic animals of the farm. When he is acquainted with the organism of their bodies, and with the functions which their several organs perform, he can usually adapt both the kind and quantity of their food to the peculiarities of their constitution, and frequently avert or overcome their tendencies to disease; and when he knows the identity in some points, and the similarity in others, between their animal sensations and his own, he will have a degree of concern for their well-being, of comprehension of their wants, and of sympathy for their ailments, far greater than he would otherwise possess, and most beneficial in effect upon both his moral character and his worldly prosperity. Any farmers who have not enjoyed access to veterinary schools, ought to employ some early leisure in picking up a little knowledge of animal anatomy from books. Anatomical articles on all the principal organs of animals will be found in their respective places in our work.

ANATOMY OF VEGETABLES. The study of the structure of vegetables by sectional cutting with the knife. This study is the true basis of the science of vegetable physiology, and of all true knowledge of the constitution and functions of plants; and, though not personally prosecuted, yet ought to be known in its results or discoveries, by every gardener and farmer. The earliest writings of any value on vegetable anatomy, were the *Anatomy of Plants*, by the English physician Grew, published in 1682; and portions of the *Opera Omnia* of the Italian physician Malpighi, published in 1687; but treatises and articles of greater or less length, and aggregately of the most minute research and a very high order of excellence, have been written by almost all of the numerous subsequent distinguished physiologists. The several parts and organs of plants, as discovered and examined by dissection, will be found described in their respective places in our work.

ANBURY. A kind of wen, or spongy wart or tumour on the legs or flanks of the horse. It is usually full of blood; and may be removed either by the fastening of a ligature round its base till it dies away, or by the application first of the knife and next of some caustic substance such as a solution of blue vitriol, to destroy its connection with the absorbent vessels. Taplin recommends that it should be carefully anointed once in three or four days with the butyr of antimony, which, he says, will effectually cure the disease.

ANBURY, AMBURY, or HANBURY. A perplexing, stubborn, and desolating disease in turnips. It takes the name of anbury from its early de-

veloping small knots or tubercles, of a form similar to the anbury in the horse; and it also bears the designations of fingers and toes and of canker,—the former from its producing such a series of united tap-roots as make the turnip have the shape of a boxer's glove, and the latter from its eventually eating away most of the interior substance of the turnip, and occasioning the rest to be fetidly putrescent.

Anbury, till a few years ago, threatened to exterminate the turnip in some districts of Britain, and even to render the cultivation of it in any district adventurous; and it has been the topic of much controversy, many theories, and general uncertainty as to at once its history, its nature, its causes, and its cure. One theory supposes it to be a topical disease, and to have been propagated from one place to another by the carriage of seeds; another supposes it to have arisen from a peculiar combination of soil, climate, and culture in one locality, and to have been propagated by infection; a third supposes it to be the consequence of an excessive or unduly prolonged cultivation of the turnip, and to have been forced into existence wherever such cultivation had been practised; a fourth supposes it to have originated in variableness and inclemency of weather throughout a season, and to be propagated or repressed according to the adverseness or favourableness of the weather of succeeding seasons; a fifth supposes it to be an inoculation from a similar disease in other varieties of the brassica tribe, and to have been propagated by the migrations of the insects by whose means it is inflicted; and a sixth supposes that it is strictly constitutional in the turnip, and must necessarily become developed whenever the plant is produced in a high or even fair degree of healthiness and strength. Nor are these theories respecting its origin and propagation so conflicting as opinions respecting its nature. One theory asserts it to be a disease in the organism of the turnip; another asserts it to be a disease in the secretions; a third asserts it to be a poisoning from some peculiarity in either soil or manure; a fourth asserts it to be consumption by an insect common to the turnip with other varieties of brassica; a fifth asserts it to be consumption by an insect peculiar to itself; a sixth asserts it to be poisoning by the voided secretions of some one or other insect; and a seventh asserts it to be commenced in organic feebleness and completed by insectal depredation. Differences of opinion as to the best means of curing or preventing it, or even as to the practicability of its prevention, are, as we shall afterwards see, quite as numerous and conflicting. Had not quite recent experience proved that thorough cultivation will not only prevent but exterminate anbury, we might probably have summed up all true existing knowledge respecting anbury in the humiliating statement, that this one disease in a single variety of vegetable has bewildered wise men and stultified science.

But we have now distinct reason for asserting that anbury is of a complex nature and diversified origin, and that it is always and most effectively prevented by such stimulating cultivation as occasions the young turnip plant to have a rapid and vigorous growth. Yet the facts which have brought out this gratifying conclusion are so recent, that—were it only for the purpose of recording curious and instructive matter for future history—we must compose a summary of previous observations and statements respecting the disease's history, appearances, and effects.

Anbury seems to have been known in Suffolk during upwards of a century; and yet it did not begin to attract the general attention of British farmers, or to make its appearance in more than two or three districts of country, till about the year 1810 or 1815. The late Arthur Young, Esq., writing in 1819, says, "To my knowledge, the disease in turnips called fingers and toes has been known in Suffolk above fifty years; and I am informed it was known long before that period. But I am quite unacquainted with the districts in which it first appeared." In the latter part of last century, and in the early part of the present, it made great havoc in Holderness, a district in the vicinity of Hull in Yorkshire; and in 1812, Mr. Spence, the entomologist, published a very sensible pamphlet, entitled 'Observations on the Diseases in Turnips, termed in Holderness Fingers and Toes.' The disease appeared in Berwickshire and Roxburghshire about the year 1799; it was supposed by some persons to have been brought thither from Holderness, yet did not become known in the vicinity of Newcastle till several years later; it was not seen in Berwickshire and Roxburghshire for thirty years after turnip cultivation had been commenced; and, from the time of its appearance till about the year 1830, it occasionally fluctuated in both prevalence and power, but on the whole made such a steady, progressive, and alarming increase as menaced all turnip-culture with speedy extermination. In 1819, the disease prevailed to a very disastrous extent, not only in these Scottish counties, but in several of the principal agricultural counties of England; in September of that year, a general meeting of the Caledonian Horticultural Society, addressed formal inquiries into its phenomena and treatment, to a number of the most eminent cultivators in Great Britain; and afterwards, communications in reply from Mr. George Sinclair of Woburn Abbey, Messrs. D. and A. Macdougall of Cessford near Kelso, the Rev. George Jenyns, prebendary of Ely, and the well-known Arthur Young, Esq., and Sir John Sinclair, Bart., were published in the Society's Memoirs. In 1828, the Highland Society offered an honorary premium for the best practical essay on the appearances and prevention of anbury, founded on the personal knowledge of the author; and in their Transactions of August 1830, they published one prize essay by the Rev. James

Farquharson of Alford, in Aberdeenshire, another prize essay by Mr. John Abbay of Kirby Hall in Yorkshire, and extracts from a communication by Mr. M. Birnie of Hyde Park near Aberdeen. From 1830 till about 1840, the disease seems to have somewhat steadily decreased; and about the latter date, it became nearly or altogether extinct on all the well-managed farms of the most thoroughly cultivated districts.

Anbury infests, not the turnip only, but the cabbage and other varieties of brassica, and even the hollyhock and some other tap-rooted plants. It frequently attacks the young cabbage in the seed-bed, and appears then in the form of a gall or wart upon the stem, in the immediate vicinity of the roots. If the wart be opened, it will be found to contain a small white maggot, the larva of a little insect; and if the wart and the maggot be removed, and the plant again placed in the soil, the latter, unless it sustain another attack, will recover from its wound, and suffer little retardation of its growth. But if the wart be not disturbed, the maggot will feed upon the alburnum till the period of transformation into the next stage of insect existence approach; and it will then gnaw its way through the exterior bark, and leave the plant in a state of disease beyond the power of any remedy. The wart has now increased into a gall, which encircles the whole stem; the alburnum is so extensively destroyed that the sap of the plant can no longer ascend; and the whole plant, in consequence of ceasing to obtain a sufficiency of moisture through the roots to compensate for the transpiration of the leaves, loses all its healthy appearance, and becomes flagging in its foliage and pallid in its colour. The swelling of the gall continues to increase; the vessels of the alburnum continue to afford a larger supply of juices than can be conveyed away; air and moisture pass, through the perforation made by the maggot, into the interior of the excrescence; the wounded vessels ulcerate; and putrefaction and death speedily supervene. The tumour has probably become larger than an ordinary hen's egg, and has a rugged and mouldy surface, and a strong and offensive smell; and the fibrous roots are generally thickened, distorted, and awry, and exhibit, through their whole length, unnatural swellings, of monstrous appearance, and seemingly occasioned by a long series of strenuous efforts in the plant to form receptacles for the sap which could no longer be spissated by the leaves.

The anbury in turnips is rarely if ever visible in plants of less than seven weeks old, and is first indicated by the loss of natural vigour in the leaves. Though the leaves of a diseased root should happen to be larger than those of a sound plant, yet, whenever they receive the rays of the mid-day sun, they decline from their natural posture into a flaccid condition; and when thus enfeebled, they are generally attacked by a minute species of acarua, and become tintured with its

delicate bluish-white web. The flagging state of the leaves is so distinct as to afford an easy and certain indication of the extent and direction of the disease athwart a field. In the earlier stages of the disease, small knobs or tubercles, occasioned by the punctures of insects, and containing the larvæ of their future progeny, appear upon the roots of the plants; and in the ulterior stages, the true roots are destroyed, the excrescences or subsidiary roots spread out in the form of digitation; and the bulb is altered in both structure and qualities, becomes thoroughly putrid, and emits an offensive smell. "Mr. Marshall very correctly describes the form which this disease assumes when it attacks the turnip. It is a large excrescence appearing below the bulb, growing to the size of both hands, and, as soon as the hard weather sets in; or it is, by its own nature, brought to maturity, becoming putrid, and smelling very offensively. On the last day of August when the bulbs of the turnips were about the size of walnuts in the husk, the anburies were as big as a goose's egg. These were irregular and uncouth in their form, with inferior excrescences, resembling the races of ginger hanging to them. On cutting them, their general appearance is that of a hard turnip, but on examining them through a magnifier, there are veins or string-like vessels, dispersed among the pulp. The smell and taste somewhat resemble those of turnips, but without their mildness, having an austere and somewhat disagreeable flavour, resembling that of an old stringy turnip." [*Mr. George W. Johnson.*] One or more galls are perceptible on the roots of a plant whose flaccid leaves indicate it to be affected; and these, as in the case of the cabbage anbury, become large excrescences inhabited by larvæ or small maggots. Each larva, in very young plants, has the appearance of a minute globule of water, and cannot be distinguished by the naked eye. As soon as the insect is prepared to leave its nidus, the excrescence becomes soft, spongy, and putrescent, the rind bursts, and a fetid smell, peculiar to decomposing vegetable matter, is emitted. Partridges appear to be very fond of the larva; and whenever they are seen to congregate among affected turnips, they are found to perforate the galls, and take out the larva. "Several insects are now attracted to the putrifying mass. A species of musca deposits its eggs on the surface. The larvæ burrow in the mass; these are followed by different species of staphylinus, pæderus, &c. The former of these seem to live on the larvæ of the musca, for two of these lived three months, while supplied with these larvæ, but died soon after the supply was discontinued. They did not appear to touch the matter of the turnip on which the larva of the fly lived. Under these circumstances, when moist weather occurs, the mass affected soon wastes away, and frequently a large root is found a mere shell." [*Mr. Sinclair.*]

The insect whose larva occurs as either cause

or accompaniment of anbury in turnips is the *curculio pleurostigma* of Mr. Marsham's *Entomologia Britannica*, the *curculio sulcicollis* of Paykull's *Fauna Svecica*, the *curculio affinis* of Panzer's *Faunæ Insectorum Germanicæ*, the *rhynchænus sulcicollis* of Gyllenhal's *Insecta Svecica Descripta*, the *falciger sulcicollis* of Dejean's *Catalogue des Coleopteres*, and the *cryptorhynchus alanda* of Germar's *Insectorum Species Novæ*. Mr. Marsham describes it as a coleopterous insect, one line and two-thirds in length, of a dusky black colour, and its breast spotted with white. Mr. Kirby, in Kirby and Spence's *Introduction to Entomology*, says, "I have bred this species of weevil from the knob-like galls on turnips, called the anbury, and I have little doubt that the same insects, or a species allied to them, cause the clubbing of the roots of cabbages. Mr. Sinclair also says, that, in its head, mandibles, jaws, &c., the larva of the turnip anbury is similar to the larvæ which live on the root of cauliflower, broccoli, and other varieties of brassica, and he observes that however many may be the larvæ inhabiting a single root, each individual occupies a distinct cell; yet he states that it appears to him to be a species of the cynips of Linnæus, and the *diplolepariæ* of Leach, Geoffroy, &c." But Mr. Sinclair probably confounded, to some extent, the galls which sometimes grow on the bulbs of turnips with the anbury which grows upon the roots. The galls on the bulbs may readily enough be mistaken for a mild form of anbury, though they are a very different disease, having a different seat, appearing at a much later period, and possessing a far less pernicious character; and these certainly are occasioned by a cynips or gall-fly, and, when opened, will be found to contain a yellowish maggot, of quite different appearance and size from that of the anbury larva. The principal mischief of the galls upon the bulbs of turnips, is an exposure of the interior to moisture and the frosts of winter, and the consequent superinduction of an earlier decay than in healthy turnips.

Anbury does not arise from any imperfection or peculiarity in the seeds of turnips. If two crops grow, in adjoining fields, from the same seed, the one may be much diseased and the other altogether healthy; and even when anbury attacks any one field, it very frequently makes but partial devastations, or appears only in small and isolated patches. Nor does anbury arise from any unfavourableness in the time of sowing, or from unpropitiousness of weather during the growth of the crop; for, if it did, it might be expected to make somewhat uniform and nearly simultaneous attacks in all districts of similar soil and character, and similarly affected by the supposed unsuitableness of meteorological circumstances to sowing and early growth; yet it is found to be both partial and capricious in its attacks upon some districts, occasionally very violent in a few, and either exceedingly slight or altogether unknown in many. Neither is anbury occasioned

by any peculiarity in the composition or chemical action of soil; for it occurs, in the same district, upon soils of very widely different and almost contrasted character, and, in the same field, appears at uncertain intervals, or in one year totally disappears and in another breaks out and spreads with virulence. Anbury, when once known in any district, is most likely to appear in fields which have been frequently cropped with turnips or which have quite recently produced either turnips or cabbage; yet it arises on such fields, only from the presence of the insect which feeds upon it, and not from any "tiring" or excrementitious poisoning of the soil by turnip cropping; for it often does not devastate more than mere patches of an old turnip field, and occasionally breaks out in fields which have not been previously cropped with turnips during many years or even within the memory of man. Farmers, therefore, may save themselves the annoyance and expense of attending to any nostrums which assume the anbury to arise from any of these causes, or even to be stimulated by their action. Yet weather has so far an effect that drought provokes and aggravates the disease, and rain averts or mitigates it. Wet weather promotes the rapid growth of the turnip, so as to accelerate its arrival at a condition in which it ceases to be liable to the disease; it enables the turnip, when affected, to contend more sturdily, by means of a copious supply of moisture, against the injury inflicted by the larva; and it prevents the leaves of an infected plant from flagging, lessens their exhausting transpiration of watery particles, and occasions to be brought up, through the organism of the ascending sap, a more copious supply of nourishment from the soil. Stagnant water or sponginess of soil, however, will produce no such good effects; but will act in the same malign manner upon turnips as upon most other crops. A free and abundant circulation of moisture, such as occurs during showery weather upon a porous soil, operates most benignly on turnips in almost any circumstances,—and not less so when they are either menaced or attacked with anbury; and this important remedy may, in most cases, be applied, during droughts, to small crops of turnips, such as those of the kitchen garden, by artificial waterings.

Soot and charcoal dust, spread to the depth of half an inch upon the surface of the land, and mixed with merely a thin superstratum of the soil, have been recommended as exterminators of anbury or preventives of its recurrence; and both are believed to operate on the double principle of finely divided carbon being offensive to insects and antagonistic of vegetable putrefaction, and the soot on the additional principle, that sulphur is very repugnant to insects. Marl also has been recommended as an exterminator; but whether chalky marl, clay marl, chalk and clay marl, chalk and silex marl, the calcareous marl of limestone alluvial, or the calcareous marl

of shell deposits, is not recorded, and possibly was not known to even the parties who applied and tested it. Yet if one variety of marl were proved to be of the most decided efficacy, another variety might be perfectly powerless or even a little noxious; and hence the want of a chemical analysis and proper nomenclature of marls, completely prevents the judicious imitation of any successful use of them either against anbury or for any other specific and difficult purpose. Common salt has been much recommended, and appears to have, in various instances, been employed with decided success; but it is very liable to be exhibited in such overdose as to be temporarily poisonous to the soil, and, even when administered in the best possible proportion, is probably an imperfect preventive. Dry hydro-sulphuret of lime, such as may easily be obtained at the public gas-works, has been recommended, in the form of a slight dressing of the surface soil, as a preventive of both anbury and the attacks of the turnip-flea. Mr. George W. Johnson, who suggests this last remedy, says, "I entertain this opinion of its efficacy in preventing the occurrence of the anbury, from an instance when it was applied to some broccoli,—ignorantly grown upon a bed where cabbages had as ignorantly been endeavoured to be produced in successive crops. These had invariably failed from the occurrence of the anbury; but the broccoli was uninfected. The only cause for this escape that I could trace, was, that just previously to planting, a little of the hydro-sulphuret of lime had been dug in. This is a very fetid, powerful compound. When dry lime purifiers are employed at gas-works, it may be obtained in the state of a dry powder; but when a liquid mixture of lime and water is employed, the hydro-sulphuret can only be had in the form of a thick cream. Of the dry hydro-sulphuret I would recommend eight bushels per acre to be spread regularly by hand upon the surface, after the turnip seed is sown, and before harrowing. If the liquid is employed, I would recommend thirty gallons of it to be mixed with a sufficient quantity of earth or ashes, to enable it to be spread over an acre in a similar manner. For cabbages, twelve bushels, of forty-five gallons per acre, would not probably be too much, spread upon the surface, and turned in with the spade or last ploughing. To effect the banishment of the turnip-flea, I should like a trial to be made of six or eight bushels of the dry, or from twenty-two to twenty-eight gallons of the liquid hydro-sulphuret, being spread over the surface immediately after the sowing, harrowing, and rolling are finished. Although I specify these quantities as those I calculate most correct, yet, in all experiments, it is best to try various proportions. Three or four bushels may be found sufficient; perhaps twelve or even twenty may not be too much." But the grand and only really efficient preventive of anbury, as we formerly hinted, is thorough cultivation as to at

once draining, tilling, and manuring. A general law of the controlling providence of God over all agriculture, is that careless cultivation is punished by eventual devastation and sterility, and that wise and sedulous cultivation is followed by soundness and luxuriance; this law associates the reflection and labour of man with his well-being, subordinates his enlightened toil to his happiness and prosperity, and comprises all the multitudinous influences which bear upon the physical history of a farm; and, in few instances, does it operate more conspicuously than in those, like the anbury, in which the ill-directed and inadequate labours of the sloven are utterly discomfited by the silent and almost invisible antagonism of one of the tiniest of insects.—*Stephens' Book of the Farm*.—*Kirby and Spence's Introduction to Entomology*.—*Marshall's Entomologia Britannica*.—*Paper of G. W. Johnson, Esq., in No. 39 of Q. Journal of Agr.*—*Paper by Mr. Stephens in No. 4 of Q. Journal of Agr.*—*Papers of Rev. Jas. Furquharson, Mr. M. Birnie, and Mr. John Abney in Transactions of Highland Society*.—*Papers of Mr. George Sinclair, Arthur Young, Esq., Messrs. D. and A. Macdougall, Rev. Geo. Jenyns, and Sir John Sinclair, Bart., in Memoirs of Cal. Horticultural Society*.

ANCHUSA. See ALKANET.

ANCHYLOSIS. A disease in animals' joints, consisting of ossification of the ligaments which unite bone to bone. Few horses which were overworked in their youth, or strained or suddenly pulled upon their haunches in maturer age, escape ankylosis in some of the bones of the back or the loins; and all horses which have, to any considerable extent, become ankylosed, are unpleasant to ride, turn with difficulty in their stall, are reluctant either to lie down or to rise, have a singular straddling action, and are popularly said to be broken-backed or chinked in the chine.

ANDROMEDA. A large genus of ligneous, evergreen, ornamental plants, of the heath family. About forty species are known to botanists; twenty-six species have been introduced to Great Britain; and about twenty well-established varieties, as well as the twenty-six typical species, are cultivated in our shrubberies and gardens. Most are neat and even handsome plants; and all grow naturally in either bogs or alpine districts, and require peat earth and a moist situation. The Jamaica species is a stove-plant; and the Japan species requires the greenhouse; but all the other introduced species, as well as their varieties, are hardy. The wild rosemary variety of the marsh species grows wild in the turf bogs of Britain, and is the only indigenous plant of the genus; the globe-flowered variety of the box-leaved species is a native of Russia; two other varieties of that species are natives of Newfoundland; the moss-like species, *Andromeda hypnoides*, is a native of Lapland; the Jamaica and the Japan species are natives of the countries whose names they bear; and all the other species are natives

of America. The sorrel-tree species, *Andromeda arborea*, is a tree forty feet high; the rigid species is a large shrub, twenty feet high; the moss-like species, the dwarf variety of the box-leaved species, the two varieties of the axil-flowering species, and all the five well-established varieties of the marsh species, *Andromeda polifolia*, are undershrubs not exceeding one foot in height; and all the other species and varieties are small shrubs of from two to six feet in height. Miller enumerates only five species; and Marshall only three. The marsh species, *polifolia*, is probably the best known; and the *latifolia*, *erecta*, *speciosa*, *media*, *minor*, *axillaris*, *calycalata*, *latifolia*, *myrtifolia*, *ventricosa*, *catesbaei*, *coriacea*, and *cærulea*, are somewhat extensively diffused. All the more common species are easily propagated by suckers, by layers, or by foreign seeds.—*Loudon's Ency. of Plants*.—*Mawe's Gardener's Calendar*.—*Miller's Gardener's Dictionary*.—*Marshall on Planting*.

ANDROPOGON. A genus of exotic grasses, of the olyra tribe. Six species—the nerve-glumed, the twisted, the lemon-grass, the two-spiked, the smooth-spiked, and the woolly—have been introduced to Great Britain; and about sixty other species are known to botanists. The smooth-spiked is a native of the Cape of Good Hope, the two-spiked and the woolly are natives of the south of Europe, and the other three introduced species are natives of the East Indies. The two-spiked and the woolly are hardy in Britain; the smooth-spiked is tender or half-hardy; and the East Indian species can be cultivated only in the stove. The two hardy species grow to the height of 12 and 18 inches. The lemon-grass species has an agreeable fragrance, and a warm, bitterish, and somewhat pleasant taste; and was formerly imported from Turkey in bundles of about a foot in length, and sold in shops as a stomachic and deobstruent. All the species are of easy culture.

ANDROSACE. A genus of small, hardy, handsome, mountaineer plants, of the primrose family. Ten species have been introduced to Britain, from Austria, Russia, Siberia, Switzerland, Italy, Denmark, and the Pyrenees; and about twenty-five other species are known to botanists. Six of the introduced species are annuals; and one is a biennial.

ANDRYALA,—popularly *Downy Snow-Thistle*. A genus of small plants, annuals, biennials, and perennials, of the composite family. They are natives of the south of Europe and the north of Africa.

ANEMOMETER. An instrument for measuring the velocity of the wind. A farmer is more interested in the direction of the wind than in its velocity; yet in all situations, he has some interest in its velocity, and in such situations as the hollows, ravines, and gorges of an upland district, he has occasionally a great interest in it. The cooling power of wind is proportional to its velocity; and both that power, and the wind's mechanical force, are sometimes of considerable

moment upon a farm. The mean force of the wind during the year is 0·855 at 9 A. M., 1·107 at 3 P. M., and 0·605 at 9 P. M. A wind moving at the rate of one mile per hour is scarcely perceptible; at 5 miles, is a gentle breeze; at 11, a pleasant brisk breeze; at 22, a gale; at 35, a strong gale; at 50, a very strong gale; at 62, a storm; at 71, a great storm; at 88, a hurricane; and at 110, a tornado, tearing up trees and throwing down houses. Lind's anemometer, which has been considered the best, consists of two glass tubes, AB and CD in *Fig. 1. Plate II.*, about nine inches long, having a bore of $\frac{4}{10}$ of an inch. These are connected, at their lower extremities, by another small tube of glass, with a bore of $\frac{1}{10}$ of an inch. To the upper extremity of the tube AB is fitted a thin metallic one, F, bent at right angles, so that its mouth may receive horizontally the current of air. A quantity of water is poured in at the mouth till the tubes are nearly half full, and a scale of inches and parts of an inch, HI, is placed betwixt the tubes. When the wind blows in at the mouth, the column of water is depressed in the tube AB, and elevated in the same degree in the other tube; so that the distance between the surface of the fluid in each tube is the length of a column of water, whose weight is equivalent to the force of the wind upon a surface equal to the base of the column of fluid. The little tube which connects the other two is made into a small aperture, to prevent the oscillation of the fluid by irregular blasts of wind. But by a simple application of the hand, and a very brief and easy arithmetical calculation, the common thermometer may be used to ascertain accurately the velocity of the wind. "Mark the temperature indicated by a thermometer in the still air; apply the hand to the ball till the alcohol rises a certain number of degrees; then mark the number of seconds that elapse till it fall exactly half the number of degrees raised. Raise the alcohol again the same number of degrees, and expose the ball to the full impression of the wind, and mark the number of seconds that it takes to fall half the number of degrees it rose. Divide the number of seconds elapsed in still air by the number of seconds elapsed in the full play of the wind, throw off 1 from the quotient, and multiply it by $4\frac{1}{2}$: the product expresses the velocity of the wind in miles per hour. For example: suppose the temperature in the still air is 50°, and that it is raised by the hand to 70°, and that it requires 100 seconds to cool down to 60°, or the half of the increase to which it was raised; suppose that it is exposed to the current of the wind, and is raised to the same height, and cools down to 60° in 10 seconds, the example will stand thus;—divide 100 by 10, which gives 10; throw off 1, and multiply 9, the remainder, by $4\frac{1}{2}$, which will give 40½ miles per hour." But this mode of measuring the velocity of the wind is subject to considerable error when the glass of the ther-

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mometer is not of the thinnest kind employed by manufacturers.

An instrument for ascertaining the wind's velocity, described in the 'Leçons de Physique de L'Ecole Polytechnique,' by Pujoux, is shown in *Plate II. Fig. 2*, where AA is the section of a plane surface exposed to the wind, and fixed to the horizontal arm C, which moves in the cylinder DD, which contains the bladder B, filled with air. This bladder is connected with the bent glass tube *tt*, containing a coloured fluid. When the wind blows against the surface AB, the circular plate E presses against the bladder B, and, by compressing the included air, forces it up the bent tube, and raises the coloured liquor. When the pressure upon the bladder diminishes, by the abatement of the wind, the bladder will recover its former figure, and the liquor will descend in the tube. The graduation of this instrument should be effected experimentally, by loading the surface AA with different weights in succession.

The following contrivances by the writer of the article ANEMOMETER in the 'Edinburgh Encyclopædia,' seem to possess several important advantages for measuring the velocity of the wind.

The first of these instruments is represented in *Plate II. Fig. 3*, where A is a plane surface, to be exposed to the wind. It is fixed at right angles to the toothed rod AB, which drives the pinion C. Round the axis D of this pinion, winds a string DE, which raises the long cylindrical weight F, out of a fluid contained in the glass vessel G. When the instrument is placed in the still air, and the weight F completely submerged in the fluid, the apparatus is in equilibrio by means of a counter-weight fixed on the axis D, on the other side of the pinion, and the index points to 0 on the scale. When the anemometer is exposed to the wind, the toothed rod AB drives the pinion C, and thus raises the weight E out of the fluid. But it is evident that as the cylinder E rises, its weight gradually increases, till it is completely raised above the fluid, when it has received an increase of weight equal to the weight of a column of fluid of the same size as the cylinder. This variation of weight which the cylinder sustains, may be increased by augmenting its size, or by employing a fluid of greater density. The length of the scale is obviously equal to the length of the cylinder, so that the circumference of the pulley or axis D should have the same length. The instrument may be accommodated to winds of any intensity, by varying the quantity of surface which receives the impression of the wind; and is graduated in the same way as other anemometers.

The anemometer represented in *Fig. 4*, measures the force of the wind by the effect which it produces in compressing a column of air, contained in the tube BC, and ball C. A short column of mercury, or any coloured fluid, is placed at B, the beginning of the scale, and the force of

the wind, concentrated by the conical mouth AB, forces the liquor up the tube, upon which the scale BC is fixed for measuring the degree of compression, and consequently the force of the wind. An index made of iron, as in Six's thermometer, may be made to float in the liquor, and remain in the part of the tube to which it was pushed by the wind. It is then drawn back to the fluid by a magnet, to be ready for another observation. If the greatest force of the wind which it is required to measure, should be able to compress a quantity of air into $\frac{2}{3}$ ths of its bulk, then the contents of the tube BC should be a little more than $\frac{1}{6}$ th of the contents of the ball C, so that the greatest wind may just force the liquor within a little distance of the ball.

The instrument shown in *Fig. 5*, depends on the same principle as the preceding, but is perhaps more commodious and accurate. The metal cap A B, bent at a right angle, is fixed upon the top of the glass tube, B, C, which communicates at C, with another glass tube, DE, of a much smaller bore, with a bulb, E, at its extremity. A quantity of mercury or any other fluid is poured into the tube BC, and of course rises to the same level *m n*, in both tubes. When the mouth A, of the instrument, is exposed to the wind, the fluid at *m* descends in the tube, and by rising in the stem DE, it compresses the enclosed air, till there is an equilibrium between the elasticity of the air and the force of the wind. In order to prevent the oscillation of the fluid, a round and thin piece of wood floats upon its surface at *m*. It is evident, that the force which balances that of the wind, arises both from the elasticity of the air in the ball and the stem, and from the weight of the column of fluid, which is raised in the tube DE, above the fluid surface *m*, in the other tube BC: but as the scale may be formed by experiment, it is unnecessary to consider the effects of these separate resistances.

It is well known that when water is exposed to the wind, the quantity evaporated in a given time is proportional to the velocity of the wind, the capacity of the air for moisture remaining the same. If, therefore, we expose to the wind a plane surface A, *Fig. 6*, consisting of sponge or coarse flannel, stretched across a metallic frame, and saturated with water, and observe the quantity evaporated in a given time, we have a measure of the wind's velocity. The square surface A is fixed at the end of the lever BCD, moving round C, as a centre, and the loss of weight is ascertained by the weight E moving along the arm CD. The plane surface is turned to the wind by the vane G. This instrument furnishes us also with the means of determining the sum of the velocities of the wind during any given period.

ANEMONE. A genus of small, ornamental, perennial plants, of the Ranunculus tribe. Four species are indigenous in Great Britain; twenty-three species have been introduced from foreign

countries; and upwards of twenty other species are known to botanists. The species *pulsatilla*, or the pasque flower, grows wild in chalky pastures in England; the species *ranunculoides* and *Appenina* grow wild in the woods of England; and the species *nemorosa* grows wild in the woods of both England and Scotland. The species *Capensis*, the only tender one of the introduced species, is from the Cape of Good Hope; and most of the other species are from Italy, Portugal, the Levant, France, Switzerland, Germany, and Siberia. The species *Capensis* is an evergreen herb; the species *coronaria*, *hortensis*, *palmata*, *sylvestris*, *pavonina*, *nemorosa*, *Appenina*, *ranunculoides*, and *thalictroides*, are tuberous-rooted plants; and all the other introduced species are deciduous herbs. No variety of any of the species grows to a height of more than 12 inches. The species *hortensis* and *coronaria*—the former from the Levant and the latter from Italy—are well-known, widely diffused, and very favourite florists' flowers; and are valued, not only for their brilliant colours, but for their great hardiness and for their capability of blooming at any season of the year. Their principal colours are white, red, blue and purple; and these, in some instances, are curiously intermixed, and form splendid variegations. Numerous new varieties have been raised from seed; but they are not individually named like tulips, hyacinths, dahlias, and pinks. Some double varieties are exquisite; several semi-double varieties are quite equal to the double ones; and even some of the single varieties are very brilliant. The roots, like those of ginger, are solid flattened masses, and are sold by weight, and multiplied by division. They love a fresh loam, and ought to be covered to the depth of three inches; and though they probably succeed best when planted in October in the south of England, and in February or March in the centre of Scotland, yet they may be planted successionally in every month of the year, and will afford an almost constant series of bloom. In unusually severe frost they require a little protection. The species next in beauty to the two very favourite species are *narcissiflora*, *dichoterna*, *Alpina*, *Virginiana*, *hepatica*, and our four indigenous species. The leaves of *Anemone nemorosa* often produce two interesting species of parasitic fungi, *Æcidium leucospermum* and *Puccinia anemones*; and the leaves of the former also produce another species, *Æcidium quadrifidum*. See *Æcidium*. Most of the species of anemone are acrimonious and detersive. An infusion of anemone is said to remove woman's obstructions, and to increase her milk; the bulbous roots, when chewed, are said to strengthen the gums and preserve the teeth; a decoction of the roots is said to cleanse corrosive ulcers, and heal inflammation in the eyes; the flowers, boiled in oil, are said to have the property of thickening the hair; and anemone ointment is said to be a good eye-salve, and an useful application to ulcers and external in-

flamations. The name *anemone* means wind-flower, and seems to have been suggested either by the extreme downy lightness of the seeds, or by exposedness and windiness of the foreign natural habitat.—*Loudon's Ency. of Plants*.—*Loudon's Ency. of Gardening*.—*Mawe's Gardener's Calendar*.—*Loudon's Gardener's Magazine*.—*Miller's Gardener's Dictionary*.—*Johnson's Farmer's Ency.*

ANEMOSCOPE. An instrument for observing the direction of the wind, or the point of the compass from which it blows. The common anemoscope—an instrument known to the ancients—may be seen on the top of every spire. A vane of thin metal is fixed at the top of a vertical rod, so that the greater part of the vane may be on one side of the rod. This rod moves upon a pivot, and always points to the quarter from which the wind blows. When great accuracy is required, the direction of the wind may be indicated, either upon a horizontal, or a vertical dial-plate. When the dial-plate is required to be horizontal, we have only to fix it upon the base in which the pivot of the rod moves, and place an index upon the rod itself. When the dial-plate is vertical, a horizontal bevel-wheel must be fixed on the vertical rod, so as to drive a vertical wheel, with the same number of teeth, fixed upon a horizontal axis, at the extremity of which is fastened the index. When the vane and the vertical rod perform one complete revolution, or part of a revolution, the horizontal wheel will make the vertical wheel, and consequently the horizontal axis, with its index, perform the same revolution, or part of a revolution. When, from particular circumstances, the dial-plate can neither be horizontal nor vertical, but forms an oblique angle with the vertical rod, the index of the dial-plate may be put in motion by Hooke's Universal Joint. This simple contrivance we owe to the ingenuity of Mr. Miller, optician in Edinburgh.—The anemoscope of Dr. Wren consists of a vane fixed to a vertical rod, on whose lower extremity is fastened horizontally a circular plate. An arm, moveable by a clock, in the direction of the radius of this circular plate, carries a pencil which, in consequence of its own motion, and the motion of the plate by means of the vane, describes upon its surface irregular lines, from which the changes of the wind may be deduced.—The anemoscope of Beaudoux is a circular box, with 16 or 32 cavities, answering to the points of the compass, fixed at the bottom of a vertical rod, moved by a common vane. About a foot above this box, the vertical rod carries a cross arm, at each of whose extremities is fixed a vessel filled with sand. When the vane moves this cross arm, the sand will evidently run into the cavities, and indicate, by the quantity of sand in each compartment, the time during which the wind has blown from the corresponding quarter. One of the vessels of sand is placed nearer the centre of the rod than the other, and throws its contents into a set of cavities nearer the centre

of the box than those which answer to the other vessel. The bottoms of each cavity are inclined planes, to facilitate the motion of the sand into a drawer below, from which it is returned into the vessel for future observation.

ANETHUM. See DILL.

ANEURISM. A tumour produced by the dilatation or rupture of an artery. An aneurism in the limb of an animal may be cured by exposing the artery, and tying it above and below the tumour.

ANGELICA. A genus of herbaceous plants, of the umbelliferous tribe. The garden and the shining species are biennials; and four other species known in Great Britain are perennials. The garden and the wild species, *archangelica* and *sylvestris*, are indigenous in England, the former in waste places, and the latter in moist woods. The garden species grows four feet high, and the wild species six feet high; the former is a cultivated plant, and the latter a weed; and both flower from June to August. The garden species was formerly much used in a blanched condition as a celery; but, at present, it is cultivated principally for the candying of its tender stalks to be used as a sweetmeat and a winter dessert. The whole plant is fragrant when bruised, and has the fame of being stimulating, anti-pestilential, and otherwise medicinal. Its seeds are cordial, tonic, and sudorific; its distilled leaves are said to be a remedy for diseases of the womb; its distilled water, in doses of three table-spoonfuls, dispels flatulence, and relieves flatulent pains; the pulverized root, in doses of a drachm, is said to be very useful in pestilential fevers and diseases of the liver; and a paste of its root and vinegar used to be carried and smelled at by physicians, during the prevalence of epidemics, as a preventive of infection. The Laplanders boil or bake the stalks, and eat them as a delicacy.

ANGELICA-TREE,—botanically *Aralia Spinoza*. A hardy, deciduous, ornamental shrub, of the *aralia* tribe. It is also called the prickly angelica, and the berry-bearing angelica. It is a native of Virginia, and was introduced to Great Britain in 1688. It usually grows to the height of eight feet; but, when soil and situation are very favourable, it attains the height of twelve feet. Its stem is of a dark brown colour, and is defended by sharp deciduous spines; its leaves resemble those of the garden angelica, have a pleasant green colour, consist of many wings, and, like the stems, are defended by strong, crooked spines; and its flowers grow in large umbels from the end of the branches, have a greenish yellow colour, and make their appearance in the end of July or beginning of August. If the soil immediately around an angelica tree be dug to a sufficient depth, the broken roots of the plant will send up new stems or young plants; or even if the broken roots be planted in a warm border, and shaded in hot weather, they will grow. This

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plant, therefore, has, in the technical language of gardeners, a spawning habit.

ANGLE-BERRIES. Small warty tumours on the skin, disagreeable in appearance, and sometimes very sore. On the eyelids of an animal, they are a great and constant annoyance; and on the teats of a cow, they both occasion the animal much pain, and render her difficult to milk. If a piece of waxed silk be tied firmly round the base of each, and tightened every day, the tumours will drop off without the effusion of blood, or the inoculation of the neighbouring parts. If they are large and very numerous, they ought to be cauterized; but if they are small and few, so that they can neither be tied nor cauterized, they ought to be daily touched with nitrate of silver, strong nitrous acid, or a strong solution of nitrate of silver, and they will speedily disappear. When angle-berries grow in great numbers, or reappear after being reduced, so as to indicate a strong constitutional tendency to their growth, this tendency will probably be destroyed by the administration of iodine. See article IODINE.

ANGORA GOAT. See GOAT.

ANGUILLÆ. A family of resurgent animalcules, found in sand, roofing-tiles, vinegar, and other substances. But those most interesting to a farmer are a kind found in certain descriptions of smutted corn. If a grain of long-kept and sooty-looking smutted corn be broken, the dry whitish matter which constitutes its internal substance, will, when examined through the microscope, be seen to change into a mass of long eel-shaped corpuscula, excessively dry, quite lifeless, or at least inert, and so densely amassed that they cannot easily be separated from one another without rupture. If such a grain be immersed for some hours in water, and have its extremity dexterously broken off without damage to the interior, a number of anguillæ, resembling minute eels, will be seen passing through the aperture, exactly like tiny bits of paste drawn into minute pieces of very fine thread-like form. When dropped into water, they scatter, fall to the bottom, appear there like so many little lines either straight or somewhat curved, and remain in that position till they experience reanimation. The anguillæ of some individual grains are reanimated in three hours or less; those of others, in four or five hours; those of others, not till twenty-four hours; and those of others, not till several days. The anguillæ even of one individual grain have such difference in the period of reanimation, that the first may be reanimated two days before the last. The phenomena of reanimation are fully as remarkable as the fact, but are too remotely connected with the great objects of our work to be a proper topic of description. If the reanimation of anguillæ, wheel-worms, and some other animalculæ, were popularly known, it might be employed with considerable effect, just as the transition of a butterfly from

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the state of chrysalis is employed by many theological writers, and as the germination of a grain of corn is employed by the Divine Word itself, as an illustration of the wonderful and glorious doctrine of the future resurrection of man.—*Spallanzani's Tracts on Natural History.*

ANGUS OAT. See OATS.

ANIMAL. An organized creature, endowed with life, and, in most instances, with the power of spontaneous motion. Living or organized beings have been subdivided by universal consent, from the earliest ages, into animals endowed with sensation and motion, and into plants destitute of both, and reduced to the simple powers of vegetation. Some plants retract their leaves when touched; and all direct their roots towards moisture, and their flowers or leaves towards air and light. Certain parts of plants even exhibit vibrations, unassignable to any external cause. Yet, these different movements, when attentively examined, are found to possess too little resemblance to the motions of animals, to authorize us in considering them as proofs of perception and of volition. They seem to proceed from a power, possessed in general by all living substances, of contracting and expanding when stimulated,—a power to which the name of *irritability* has been assigned. The fibres composing the heart of animals alternately expand and contract, altogether independent of the will of the animal; and thick hair will grow on the skins of some animals, when removed into a cold climate. As we neither ascribe volition nor sensation to the heart or to the hair, so we cannot attribute these qualities to the heliotrope, to the sun-flower, or to the sensitive plant. The nice distinction of character must be cautiously observed, between sensation and mere irritability: like the higher powers of reason and instinct, they are

“For ever separate, yet for ever near.”

The power of voluntary motion in animals necessarily requires corresponding adaptations, even in those organs simply vegetative. Animals cannot, like plants, derive nourishment from the earth by roots; and hence they must contain within themselves a supply of aliment, and carry the reservoir with them. From this circumstance is derived the first trait in the character of animals. They must possess an intestinal canal, from which the nutritive fluid may penetrate by a species of internal roots, through pores and vessels into all parts of the body. The organization of this cavity, and of the parts connected with it, ought to vary according to the nature of the aliments, and the transformations necessary to supply the juices proper to be absorbed; whilst the atmosphere and the earth have only to present to vegetables the juices already prepared, when they are immediately absorbed.

Animal bodies, having thus to perform more

numerous and varied functions than plants, ought to possess a much more complicated organization; and, in consequence of their several parts having the power of changing their position relatively to each other, it becomes necessary that the motion of the fluids should be produced by internal causes, and not be altogether dependent on the external influences of heat and of the atmosphere. This is the reason that animals are endowed with a *circulating system*, or organs for circulating their fluids, being the second characteristic peculiar to animals. It is not so essential, however, as the digestive system, for it is not found in the more simple species.

The complicated functions of animals require organized systems, which would be superfluous in vegetables; such as, the muscular system for voluntary motion, and the nerves for sensation. It was also necessary that the fluids should be more numerous and varied in animals, and possessed of a more complicated chemical composition than in plants, in order to facilitate the action of these two systematic arrangements. Therefore, another essential element was introduced into the composition of animals, of which plants, excepting some few tribes, are generally deprived; and while plants usually contain only three elements, oxygen, hydrogen, and carbon, animals add to these a fourth, namely, azote or nitrogen. This difference in chemical composition forms the third trait in the character of animals.

Plants derive their nourishment from the soil and atmosphere, and thence obtain water, composed of oxygen and hydrogen; also, carbonic acid, which is a compound of carbon and oxygen; while the atmosphere yields an unlimited supply of air, composed of oxygen and nitrogen, with a slight mixture of carbonic acid. From these materials, the supplies necessary to preserve their own composition unaltered are obtained; and, while hydrogen and carbon, with a certain portion of oxygen, are retained, they exhale the superfluous oxygen untainted. The nitrogen, on the contrary, is either absorbed in very small quantities, or altogether rejected. Such is the theory of vegetable composition; in which one of the most essential parts of the process, namely, the exhalation of oxygen, can only be performed by the assistance of light. When plants are deprived of light, an opposite effect ensues. Instead of giving off oxygen gas, and absorbing carbonic acid, the reverse takes place; and carbonic acid is disengaged, while oxygen is absorbed. The effect of plants upon the air is, therefore, to increase its purity during day-light, but to deteriorate its quality during the darkness of night.

Animals require for their nutriment, directly or indirectly, the same substances which enter into the composition of vegetables, namely, hydrogen, carbon, and a certain portion of oxygen.

But, in addition to these, it is essential, for the preservation of their peculiar constitution, that they accumulate a much larger portion of nitrogen, and disengage any excess of hydrogen, and especially any superfluity of carbon. This is performed by respiration, or breathing, in which process the oxygen contained in the atmosphere combines with the excess of hydrogen and carbon in the blood; with the former of these, it forms watery vapour, and with the latter carbonic acid. The nitrogen, to whatever part of the system it may penetrate, seems chiefly, though not altogether, to remain there. The quantity of nitrogen retained in the system varies with the seasons, being greater in summer, and less in winter. The degree of variation is different for animals of different species: in some it is very small in quantity, while in others it is equal to their entire bulk.

The effects produced upon the atmosphere by plants and animals, are of an opposite kind; the former decompose water and carbonic acid, while the latter reproduce them. Respiration forms the fourth characteristic of animals, and is the most distinguishing function of the animal frame; namely, that which forms its essential difference from all other beings, and in a manner constitutes it an animal. So important is its influence over the whole body, that we shall presently be able to show, that animals perform the functions of their nature with greater or less perfection, according as their respiration is more or less perfect. Thus we perceive that animals are distinguished from plants by the following characteristics:—1st, They are possessed of an intestinal canal; 2dly, Of a circulating system; 3dly, Nitrogen enters largely into their composition; and, finally, They are endowed with organs adapted for respiration.

To a person who has considered life only in man, or in those higher animals which most resemble him, it appears almost superfluous to explain the essential difference between an animal and a plant. If there existed upon the face of the earth only such animals as birds, fishes, or quadrupeds, there would then be no occasion to enlarge so fully upon the distinctions in their functions: the line drawn by the hand of Nature would suffice. We should readily be preserved from error on this point by their senses, their voluntary motion, the symmetry and complexity of their structure, but, above all, by the instinct which directs their actions. Then we might say with Linnæus, "*Vegetabilia crescunt et vivunt; Animalia crescunt, vivunt et sentiunt*" (Vegetables grow and live; Animals grow, live, and feel); and this definition would be as accurate as it is brief. We should not be obliged to separate corals, polypi, insects, crustacea, and symmetrical shells, from the vegetable kingdom. But such is not the case. All animals do not exhibit the distinctive marks of complicated structure and voluntary motion. This may be easily inferred from

the fact, that Tournefort, a man of great talents, and an able naturalist, actually formed nine genera in the seventeenth family of his botanical system with those polypi which were known to him and to his learned contemporaries. At a later period, Trembley hesitated for a long time before he could determine whether the hydra was an animal or a plant; and the experiments which he performed to determine the question have been admired by all the philosophers of his time. The dexterous manipulations of Trembley are the more remarkable, as Peyssonel had previously observed that minute animals inhabit the different compartments of the corals. This discovery was extended by Ellis and Solander to all kinds of polypi; while Donati, Réaumur, and B. de Jussieu, brought the subject prominently forward in their public lectures and writings. The question, however, still remained in an unsatisfactory state, and attracted the attention of the distinguished naturalists of the eighteenth century. Buffon proposed to establish an intermediate class between animals and plants. Linnæus adopted this suggestion, although it proceeded from Buffon; and rendered the distinction permanent by the title of zoophytes, or animated plants. The celebrated Pallas followed Linnæus; Cuvier adopted the word and the distinction; while Lamarck rejected them both. These doubts and differences of opinion among enlightened men could only have proceeded from the obscurity of the subject. One cause of the obscurity arose from the false direction which their studies had unfortunately taken. Confining themselves to their cabinets, naturalists remained too far from Nature. They had found solid bodies—corals, sponges, alcyonia, polypi, of innumerable shapes, sometimes covered with soft and moveable bodies, and sometimes without them. Instead of considering the soft body as the artificer of the solid mass, they believed that the latter produced the former; and as the solid masses were observed to grow and vegetate, they were hastily considered to be plants, while the soft bodies were regarded as the flowers of these extraordinary vegetables. The error was farther confirmed by the circumstance, that at the particular period when these polypi reproduce other beings of the same species, their bodies are covered with little buds and shoots, which bear a great resemblance to certain flowers, the structure of which cannot be very distinctly perceived. But when these supposed flowers were observed to be endowed with spontaneous motion, and that they were possessed of sensation, a great difficulty arose; and the name of zoanthes, or *animated flowers*, was assigned to them. It has now, however, been completely ascertained that the polypi themselves fabricate these solid apparent vegetables, which serve for their abodes. They secrete them in very nearly the same manner as the mollusca form their shells; the teredo its testaceous tube; the lobster its crustaceous envelop; the tortoise its shield; the fishes their

scales; insects their elytra or wing-cases; birds their plumage; the armadillo his scaly covering; the whales their horny laminae; quadrupeds their skins and organs of defence; and man, his hair, nails, and cuticle. In all these beings there are to be found some parts which vegetate; and if it were necessary to class with plants all beings which are found to vegetate in any of their parts, we ought, consistently, to include all the animals just named with zoophytes or animated plants of Linnæus and Pallas.

The following are the characters by which we may always ascertain whether a living being organized, growing, drawing in nutriment, possessing an internal temperature peculiar to itself, and reproducing its kind, be an animal or a plant. If it be irritable to the touch, and moves spontaneously to satisfy its wants,—if it be not deeply rooted in the soil, but only adhere to the surface,—if its body be provided with a central cavity,—if it putrefy after death,—if it give out the ammoniacal odour of burnt horn,—and finally, if in its chemical composition there be found an excess of azote over carbon,—then we may be certain that it is an animal. But if, on the contrary, the doubtful being under examination enjoy no lasting or spontaneous power of motion,—if it be destitute of an internal cavity,—if it be deeply inserted in the soil,—if, when detached, it speedily fade and die,—if, when dead, it merely ferment, but do not putrefy,—if it burn without the odour of a burnt quill or horn,—and if its residue be very considerable and chiefly carbon,—then we may venture to declare it to be a plant. These characters are sufficient, and can, in general, be easily ascertained. In this enumeration, no allusion has been made to sensation as a distinctive mark of the two classes of living beings; because, in the lowest classes of animals, where alone any difficulty can arise, it is only from the property of irritability that we can infer sensation. The phenomena of reproduction have likewise not been alluded to, because it is in the lowest animals, which we are the most likely to confound with plants, that this power is still involved in great obscurity, or altogether unknown. It is not, as we might at first sight suppose, the most perfect, or, to speak more correctly, the most complicated plants that are likely to be mistaken for animals. A moment's reflection will readily show how utterly impossible it is to confound a plant, bearing leaves and flowers, with any animal whatever. But it is otherwise with the less characterized beings; and the animal and vegetable kingdoms may be compared to two mighty pyramids, which touch each other by their bases, while their opposite vertices diverge to two infinitely remote points in either direction.

"If we divest ourselves of the popular prejudices in favour of long-established divisions," says Cuvier, "and consider the animal kingdom upon the principles already laid down, without reference to the size of the animals, their utility, the

greater or less knowledge we may have of them, or to any of these accidental circumstances, but solely in reference to their organization and general nature, we shall find that there are four principal forms, or (if we may use the expression) four general plans, upon which all animals appear to have been modelled. The minor subdivisions, by whatever titles they may be ornamented by naturalists, are merely slight modifications of these great divisions, founded upon the greater development or addition of some parts, while the general plan remains essentially the same.

1. VERTEBRATA—*Vertebrated Animals.*

"In the first of these forms, which is that of man, and of the animals most resembling him, the brain and the principal trunk of the nervous system are enveloped in a bony covering, composed of the cranium or skull, and the vertebrae or bones of the neck, back, and loins. To the sides of this medial column are attached the ribs, and the bones of the limbs, forming collectively the framework of the body. The muscles, in general, enclose the bones which they set in motion, and the viscera are contained within the head and trunk. Animals possessed of this form are called vertebrated animals (*Animalia vertebrata*) from their possessing a *vertebral* column or spine. They are all supplied with red blood, a muscular heart, a mouth with two jaws, one being placed either above or before the other, distinct organs of sight, hearing, smell, and taste, in the cavities of the face, and never more than four limbs. The sexes are always separate, and the general distribution of the medullary masses, with the principal branches of the nervous system, are nearly the same in all. Upon examining attentively each of the parts of this extensive division of animals, we shall always discover some analogy among them, even in species apparently the most removed from each other; and the leading features of one uniform plan may be traced from man to the lowest of the fishes." The following are examples of vertebrated animals: Man, quadrupeds, whales, birds, serpents, frogs, tortoises, herrings, carps, &c.

2. MOLLUSCA—*Molluscous Animals.*

"In the second form of animals we find no skeleton. The muscles are attached solely to the skin, which forms a soft envelop, capable of contracting in various ways. In many species earthy laminae or plates, called shells, are secreted from the skin, and their position and manner of production are analogous to those of the mucous bodies. The nervous system is placed within this covering along with the viscera; and the former is composed of numerous scattered masses, connected by nervous filaments. The largest of these masses are placed upon the œsophagus, or gullet, and are distinguished by the term *brain*. Of the four senses which are confined to particular organs, we can discover traces only of taste and of sight,

but the latter is very often found wanting. In only one family, however, there are exhibited the organs of hearing. We always find a complete circulating system, and particular organs for respiration. The functions of digestion and of secretion are performed in a manner very nearly as complicated as in the vertebrated animals. Animals possessed of this second form are called molluscous animals (*Animalia mollusca*) from the Latin, *mollis*, soft. Although the general plan adopted in the organization of their external parts is not so uniform as in the vertebrated animals, yet, in so far as regards the internal structure and functions, there is at least an equal degree of mutual resemblance." The cuttle-fish, oyster, slug, and garden-snail, are familiar instances of this class of animals.

3. ARTICULATA—Articulated Animals.

"The third form is that which may be observed in insects and worms. Their nervous system consists of two long cords, extending the entire length of the intestinal canal, and dilated at intervals by various knots, or ganglions. The first of these knots, placed upon the œsophagus or gullet, and called the brain, is scarcely larger than any of the others, which may be found arranged along the intestinal canal. It communicates with the other ganglions by means of small filaments, or threads, which encircle the œsophagus like a necklace. The covering of their body is divided into a certain number of ring-like segments, by transverse folds, having their integuments sometimes hard, sometimes soft, but always with the muscles attached to the interior of the envelop. Their bodies have frequently articulated limbs attached to the sides, but they are also very frequently without any. We shall assign the term articulated animals (*Animalia articulata*) to denote this numerous division, in which we first observe the transition from the circulating system in cylindrical vessels of the higher animals, to a mere nutrition, by imbibing or sucking in the alimentary substances; and the corresponding transition, from respiration through particular organs, to one performed by means of tracheæ, or air-cells, dispersed throughout the body. The senses most strongly marked among them are those of taste and sight. One single family exhibits the organ of hearing. The jaws of the articulated animals are always lateral, but sometimes they are altogether wanting." As instances of this form, we may mention the earth-worm, leech, crabs, lobsters, spiders, beetles, grasshoppers, and flies. From the circumstance of their coverings, or limbs, being divided, or jointed, they derive the name of "articulated," from the Latin *articulus*, a little joint.

4. RADIATA—Radiated Animals.

"To the fourth and last form, which includes all the animals commonly called zoophytes, may be assigned the name of radiated animals (*Ani-*

malia radiata). In all the other classes the organs of motion and of sensation are arranged symmetrically on both sides of a medial line or axis; while the front and back are quite dissimilar. In this class, on the contrary, the organs of motion and of sensation are arranged like rays around a centre; and this is the case even when there are but two series, for then both faces are similar. They approach nearly to the uniform structure of plants; and we do not always perceive very distinct traces of a nervous system, nor of distinct organs for sensation. In some we can scarcely find any signs of a circulation. Their organs for respiration are almost always arranged on the external surface of their bodies. The greater number possess, for intestines, a simple bag or sac, with but one entrance; and the lowest families exhibit nothing but a kind of uniform pulp, endowed only with motion and sensation." The following are instances of this singular class of animals:—The sea-nettle, polypus, hydra, coral, and sponge. The name zoophyte is derived from two Greek words, ζῷον (*zoon*), an animal; φυτόν (*phyton*), a plant; while that of *radiata*, derived from the Latin, evidently points out the *radiated* or *ray-like* arrangement of their parts. "Before my time," says the Baron Cuvier in a note to his first edition, "modern naturalists divided all Invertebrated Animals into two classes—Insects and Worms. I was the first who attacked this view of the subject, and proposed another division, in a paper read before the Society of Natural History at Paris, the 21st Foreal, year iii. (or 10th May, 1795), and which was afterwards printed in the '*Decade Philosophique*.' In this paper, I pointed out the characters and limits of the Mollusca, the Crustacea, the Insects, the Worms, the Echinodermata, and the *Zoophytes*. The red-blooded worms, or Annelides, were not distinguished until a later period, in a paper read before the Institute, on the 11th Nivose, year x. (or 31st December, 1801.) I afterwards distributed these several classes into three grand divisions, analogous to that of the *Animalia Vertebrata*, in a paper read before the Institute in July 1812, and afterwards published in the *Annales du mus. d'Histoire Nat.* tome xix."

ANIMAL CHEMISTRY. Organic bodies are distinguished from inorganic by always consisting of two or more of a few elements, carbon, hydrogen, oxygen, and nitrogen, with a few others; by consisting usually of a large number of equivalents, and by consequently being complex in their composition; by their ready decomposition or separation into simpler forms of matter. Many of them have also a compound radical, as basis, composed of two or three elements, carbon and hydrogen, or these with nitrogen, which act as elements combining oxygen, sulphur, &c., and their oxides with acids. We may distinguish between organic and organized bodies; the latter, while in connection with the plant or animal, partaking of its vitality and consequently

not being obedient to the decomposing laws of affinity, but rather employing these forces to elaborate materials from the organic matters around them in order to reproduce themselves. The fibrin and albumen of the blood are of this character. Organic bodies are produced by the joint action of those organized, such as sugar, gum, oily matters, vegetable acids, alkaloids, &c.

The organic and organized matters produced by plants constitute the food of animals, which employ them partly for nutrition and partly for combustion. The important organized constituents of the animal system are all nitrogenous; and hence the necessity of nitrogenous food to supply their gradual waste and decay. Starch, gum, sugar, oils, &c., containing no nitrogen, support life but for a short time, their principal use being to supply carbon for combustion, where-with the heat of the body is maintained.

In respiration the amylaceous and oily substances, &c., are burned, their oxygen uniting with as much of their hydrogen as is necessary to form water, while their carbon and the excess of hydrogen are converted into carbonic acid and water. The dark venous blood absorbs oxygen from the air in the lungs becoming of a florid red, and arterialized; but the greater part of the oxidation takes place in the extreme capillaries, from which the venous blood conveys carbonic acid to the lungs, where it parts with it, takes up oxygen, and becomes again arterialized. This oxidation appears to be sufficient to account for animal heat, and hence we may view the animal frame as an apparatus of combustion, in which the organized and organic substances generated by plants are burned and converted into simpler forms of matter, carbonic acid, water, &c.

To supply this combustion and the waste of the animal body, the organic materials of food enter into the system by simple absorption, animals merely assimilating without organizing them. It has been shown by the analyses of Mulder and others that fibrin, albumen, and casein have the same composition, whether obtained from vegetables or animals, whence Liebig draws the conclusion that animals do not organize them, but draw them ready formed from plants, the herbivorous receiving them directly, carnivorous animals indirectly.

The minutiae of the operations of respiration, digestion, and the various animal functions are still subjects of speculation and research, nor is it desirable in a practical work to enter on this field until it shall have been more fully explored. Dumas, Boussingault, and others maintain that the fatty matters are not organized by the animal, but received ready formed from plants; while Liebig holds that they are due to the metamorphosis of amylaceous and other portions of food within the animal frame.

Certain it is that a path of research has been opened by the surprising discoveries in Organic chemistry, which bids fair to unfold many of the

hitherto concealed operations in the complex system of animals, which were formerly referred to the indefinite action of vitality, and promises a clearer view of the cause and state of disease, with a more certain application of remedies on sound chemical principles. For farther details, refer to RESPIRATION and DIGESTION; to the substances, ALBUMEN, CASEIN, FIBRIN, GLUTEN, LEGUMIN, and PROTEIN; and farther, to the articles BILE, BLOOD, CHYLE, FAT, URINE, &c.

ANIMAL FLOWER. A genus of marine animals, systematically called Actinia, belonging to the order Mollusca, and class Vermes of Linnæus. In the classification of Cuvier and Dumeril, the actinia rank among the zoophytes. Many species of these animals are extremely beautiful, both from the vivid and variegated colours, red, green, yellow, blue, and orange, which distinguish them, and also from the delicacy and elegance of their figure. From the external appearance of the actinia, and also the property of contracting itself, and unfolding the numerous tentacula surrounding the mouth, it has derived its name. Most of the species with which we are acquainted are of a cylindrical figure; but a few are funnel or trumpet-shaped, or like a fig, and some approach more to an angular form. See Plate X. These animals are found firmly attached by the base to rocks within the flowing of the sea, or stones among the sand. Several species dwell in the holes or cavities of the rocks, displaying themselves fully when the tide reaches them, but suddenly retreating on the approach of danger, and closing themselves firmly up when the sea recedes. Their adhesion is so strong, that they may be torn asunder before they voluntarily separate from these various substances. Their size is extremely various, from the misilla, which is about the size of a large pea, and is said to be the principal food of the whales in the north seas, to others which are six or seven inches, and even more, in diameter. Full grown Actiniæ are susceptible of an extraordinary degree of inflation, though the real substance composing their body is very small in quantity: a noose being cast over the body of a large one, and pulled tight, the animal contrived to withdraw itself, and left the circle only six lines in diameter. Its body consists of a thin hollow membrane, which may be blown up like a bladder, and the air thus blown in by the mouth distends the tentacula. The great inflation of the animal apparently depends solely on the quantity of water imbibed; no two are found of equal size, probably on that account; and, from what we have observed, we apprehend that the growth of the animal is extremely slow.

The actiniæ are remarkably voracious: one of them will devour a substance half as large as itself, the body being then distended far over the base. Their food consists of fish, crabs, muscles, and other marine animals: and they also greedily swallow flesh, which, after a considerable interval, is rejected in a mass of an ovoidal figure.





The long retention is a certain indication of the health of these animals. It is said, that devoured muscles and crabs are disgorged with the shells close, though their substance is consumed. Of the former, we have seen some escape unhurt after being retained several hours. The animal flower is capable of very slow progression only; and lies in wait for its prey, spreading abroad its numerous tentacula, which are susceptible of exquisite feeling. While the tentacula are thus displayed, the moment one of them touches the prey, it, by some means unknown to us, adheres; another is immediately applied, and the rest successively, until the victim, if living, is overpowered, and literally swallowed alive. Probably the tentacula are perforated, and closed at the extremity by a kind of sphincter, which may be opened at the will of the animal, and allow the water indating it to escape. Notwithstanding their extreme voracity, the actiniae can endure long protracted abstinence. They survive above a year, perhaps considerably longer, without any sustenance but what invisible particles disseminated in the sea-water may afford. Then they diminish in size, and if the water is not renewed for months, they generally become close and contracted, frequently casting off exuviae, and seldom or never displaying the tentacula: but they immediately expand on a new supply, and soon appear as healthy and vigorous as ever.

The actiniae apparently transport themselves to any considerable distance from their abode, by detaching the base, the under part of which is kept inflated, and they are thus carried by the waves in a reversed position. But, independent of this, their adhesion to rocks, stones, or other substances, is so powerful, that we have found no method of detaching them without injury, but violent and continued agitation of the water, an expedient which naturalists seem hitherto to have overlooked.

The generation of the actiniae is not clearly ascertained. They appear to be hermaphrodites, and to propagate without the sexual union. The number of young is various, from one to at least twenty, which are produced by the mouth. The Abbe Dicquemare had studied these creatures ten years before discovering this fact; but it was observed long before by Ellis. The period of propagation, in a state of confinement, is not limited to any particular season. It commonly takes place in autumn, which seems consistent with what probably succeeds in a state of nature. The young, according to our observations, have only one row of tentacula.

The actiniae also propagate by spontaneous division, it is said, and the divided part becomes a perfect animal. When the period of this phenomenon approaches, it appears restless and disturbed; various extensions, contractions, and contortions of the body ensue, amidst which, several fragments separate from the lower part towards the base. These, though at first rude and shape-

less, are gradually unfolded into new actiniae, with all the parts and proportions of the old ones. We have not witnessed this mode of propagation, it is true, and perhaps it but rarely happens. We know however that there is a species of planaria, common in Scotland, which propagates in a manner analogous. The tail separates from the body: it remains contracted, and almost motionless. Should the temperature of the atmosphere be favourable, a new head shoots forth from the upper extremity, similar, in all respects, to that of the parent-animal; while, in the meantime, the parent, whose activity and motion have hardly undergone any sensible interruption, acquires a new tail. But, independent of the natural modes of generation, the animal-flower enjoys the property of reproducing the parts lost or destroyed, in an astonishing degree. Not only are full and perfect actiniae produced by division into two, or more, portions, with the knife; but, on tearing these from the place of adhesion, the very shreds, or fragments, left of the base, regenerate into complete animals, with all the members peculiar to their species. Experiments with these minute sections are not uniformly attended with success. Large shreds perish, and the small ones must be severed clean off. A single shred often produces several anemones, which sometimes remain connected, and become monsters, though commonly detaching themselves asunder.

Actiniae frequently change their skin. The colour then appears clearer, and somewhat lighter. We apprehend that all darken with age; and it is known that some are of a different hue in autumn and winter, from what they exhibit in spring and summer. Actiniae die when kept in fresh-water: they scarcely move, and their brilliant colours fade. They can bear a temperature as low as 45° with impunity; but the exact degree of cold destructive to them is not yet ascertained. From several experiments, it appears that they suffer pain from 95 to 99° of heat, and lose their hold at 115° : increasing it still further, 144° destroys them. When dying from disease, they grow flaccid, contracted, unable to inflate themselves, and gradually waste away. Sometimes repeated supplies of water will protract life, and infuse vigour into them; and their death and dissolution are evidently accelerated without it. It is said that these animals suffer nothing from a vacuum; and that they neither close on the exhaustion of the air, nor open on returning it.

The anatomical structure of the actiniae is little understood. Cuvier observes, that nothing resembling nerves is to be found in them, yet they possess a delicate sense of feeling; and although eyes seem entirely wanting, they are sensible of the presence of light, which, in general, seems to produce some agreeable sensation. We cannot explain by what means their powerful adhesion is occasioned; whether or not it is simply by exclusion of the surrounding fluid; nor do we know how the tentacula retain their prey; whether it

be by some means analogous, or by a gelatinous substance of a peculiar nature. Several species of actiniae are edible, and even very sapid. Plaucus says they are ate in Italy; and, according to Rumphius, they are also an article of food in Amboyna.

ANIMAL FOOD. Either the food of animals, or flesh and other animal substances used as food. In both senses, but particularly in the former, it will be noticed under the words **FODDER, FOOD, NUTRITION**: which see. In the latter sense, we have to refer the reader to the article **ALIMENTARY PRINCIPLES** for a general view of the subject of diet. For the following excellent observations on the undue use of animal food we are indebted to an article in the 'Athenæum' journal, on a recently published work entitled, 'Fruits and Farinacea the Proper Food of Man; being an attempt to prove from History, Anatomy, Physiology, and Chemistry, that the Original, Natural, and Best Diet of Man is derived from the Vegetable Kingdom. By John Smith.' "The question," says the reviewer, "is, what kinds of food are the best adapted for replenishing the waste, and restoring the healthful vigour of the organic functions? We say healthful; for it is an important fact, that food may be too nutritious—too concentrated for the bodily organs to convert into the requisite substances, with the ease, expedition, and efficacy necessary to health. 'The opinion is pretty generally entertained, that the amount of nutriment in animal food is much greater than is contained in any vegetable production; but this is undoubtedly a mistake. Flesh, from its stimulating qualities, imparts a feeling of strength, and is considered to be more nutritious than any other kind of food. It, however, not only exhausts the stomach more in the process of gastric digestion, but works the whole organic machinery of life with more rapidity and intensity; and therefore causes a proportionably greater waste of the substance of the organs in a given time; and, consequently, increases the demand of the system for fresh supplies of aliment.' Chemical analysis may be usefully adduced in behalf of the comparative nutriment of various kinds of food. Beef, mutton, and other kinds of flesh, we are told, contain only 28 per cent. of nutritious matter; while wheat is said to contain 95, barley 92, rice 88, oats 74, pease 57, and potatoes from 20 to 26. Flesh meat, therefore, is not intrinsically more nutritious than potatoes. But it is so great a stimulant, that by raising the spirits, and hurrying the process of transformation, it is thought to be the more invigorating. This artificial and unnatural excitement is like that which is produced by spirituous liquors, or any other liquors in which there is a large proportion of alcohol. Though while the stimulation continues a person is able to work harder, this excitement of the nervous energy and quickening of the circulation is invariably followed by a corresponding depres-

sion. And when stimulants become habitual, they really become necessities. The exhaustion by which they are inevitably followed very often incapacitates for the duties of life, until recourse is had to the same artificial means of reanimation. In such cases, the habit can be changed by slow degrees only, and by a greater exercise of self-denial than falls to the lot of most people. By the progressive reduction of the quantity of stimulating food, and a corresponding increase in the quantity of the farinaceous, the bodily machine acquires not only increased vigour, and the spirits more equanimity, but the organization becomes more durable as well as more healthy. But, on the other hand, the diet of man may have too little of the stimulating. Where the nutritive properties only prevail, the bodily functions are sluggishly performed, and a kind of stupor creeps over the frame.

"The comparative nutriment contained in the various articles of food used in the country, forms so important a subject that we are induced to give a tabular view of the proportion in every 1,000 parts:—

Bones,	519	Rye,	792
Mutton,	290	Oats,	742
Chicken,	270	Almonds,	650
Beef,	260	Tamarinds,	640
Veal,	250	Plums,	290
Pork,	240	Grapes,	270
Blood,	215	Apricots,	260
Codfish,	210	Potatoes,	260
Sole,	210	Cherries,	250
Brain,	200	Peaches,	200
Haddock,	180	Gooseberries,	180
White of Egg,	140	Apples,	170
Milk,	72	Pears,	160
Wheat,	950	Beet Root,	148
Nuts,	930	Strawberries,	120
Pease (dry),	930	Carrots,	98
Barley,	920	Cabbage,	73
Morels,	896	Turnips,	42
Beans (dry),	890	Melons,	30
Rice,	880	Cucumber,	25
Bread,	800		

"Another element of health, and consequently of strength, is the facility of digestion. From Dr. Beaumont's Tables it appears that the following articles were converted into chyle, viz., digested in the times indicated:—

Rice, boiled soft,	n. m.
Apples, sweet and ripe,	1 0
Sago, boiled,	1 30
Tapioca, Barley, Stale Bread, Cabbage with vinegar, raw, boiled Milk and Bread, and Milk cold,	1 45
Potatoes, roasted, and Parsnips, boiled,	2 0
Baked Custard,	2 30
Apple Dumpling,	2 45
Bread Corn, baked; and Carrots, boiled,	3 0
Potatoes and Turnips, boiled; Butter and Cheese,	3 15
Tripe and Pigs' Feet,	3 30
Venison,	1 0
Oysters, undressed; and Eggs, raw,	1 35
Turkey and Goose,	2 3
Eggs, soft boiled; Beef and Mutton, roasted or boiled,	2 30
Boiled Pork, stewed Oysters, Eggs, hard-boiled or fried,	3 0
	3 30

Domestic Fowls,	4 0
Wild Fowls; Pork, salted and boiled;	
Suet,	4 30
Veal, roasted; Pork, and salted Beef,	5 30

"Both of these tables are instructive, and deserve attention.

"We have already observed that food may be too nutritive for health. Innumerable instances might be adduced in support of this fact. Take one or two in regard to inferior animals;—'The dog fed by Majendie on white bread and water died in the course of seven weeks; but another fed by him on brown soldiers' bread did not suffer. When dogs were fed on sugar and water they died in a month; but if a considerable portion of saw-dust be mixed with the sugar their health will not be affected by it, although they are naturally carnivorous animals. It was also shown that an ass fed on rice died in fifteen days; but if a large quantity of chopped straw had been mixed with the rice he would have continued to live and be well. Horses fed exclusively on meal or grain will die in a short time; but mix their meal or grain with a suitable proportion of cut straw or wood shavings, and they will thrive and become fat. And it is an interesting fact, that if horses be fed on grain alone, with the exception of water, for a number of days, they will instinctively gnaw the boards, or whatever woody substance is within their reach.' But the truth is equally established in respect to mankind. There are instances on record where fine biscuit has been found injurious to the health of a ship's crew; while good health has been the lot of those who lived on the very coarsest bread. It has been justly observed by Knight, that bread made of (fine) wheat, when taken in large quantities, has, probably, more than any other article of food in use in this country, the effect of overloading the alimentary canal; and the general practice of French physicians points out the prevalence of diseases thence arising among their patients. And Dr. Beaumont observes, that a diet too nutritive is probably as fatal to the prolongation of health and life as that which contains an insufficient quantity of nourishment. Dr. Prout, too, contends, that bread made with undressed flour, or even with an extra quantity of bran, is the best for us.

"The gist of the matter lies in a small compass. While, on the one hand, we consume more than double—perhaps more than treble—the quantity of flesh meat that we ought, on the other, our habits in this respect are so inveterate that no one can or will make an entire change in them, and that few will attempt even the smallest alteration. If, as before observed, we could be persuaded to confine ourselves to animal food two or three days a-week, and then to one meal only, there would soon be less need of the physician, and life would be protracted beyond its present average duration. Nor can there be any doubt that the intellect is rendered clearer by a diet in

which animal food is sparingly admitted. This, we believe, has been experienced by most literary men, and, indeed, by students of every kind. But total abstinence from it is a very different thing. However it might agree with individual constitutions, it could not, perhaps, be adopted without extreme risk, by the majority amongst us,—not even by degrees.

"Mr. Smith takes it for granted, that as the human species multiplies (at least in this country), it will be impossible to provide animal food for them; we shall not be able to rear the requisite number of flocks and herds, and consequently farms must be made to yield grain and vegetables only. According to him, the estimated produce of an acre of land is, of—

Mutton,.....	228 lb.	per year,	or 10 oz.	per day.
Beef,.....	182½	—	8	—
Wheat,.....	1,526	—	4½ lb.	—
Indian Corn,.	1,100	—	3	—
Potatoes,.....	22,400	—	61	—

"Assuming the population of the United Kingdom to be twenty-eight millions, and the number of acres in cultivation about twice that number, and we have two acres to each individual. If the land were made to produce fruit, grain, and vegetables only, the old adage,

'When every rood of ground maintained its man,' would be realized, and consequently eight times the present population, or two hundred and twenty-four millions, would be supported, without any need of foreign aid. Here is comfort equally for the rich and for the poor."

We may observe here that all animal substances used as food, if heated to the temperature of boiling water in vessels from which the air is completely excluded, may be kept in close vessels for fifteen years without losing even the slightest degree of their freshness and sound flavour. All putrefaction in animal substances is effected by the action of oxygen in the atmosphere upon azote in their juices; and hence the preservation of these substances by heating and by total exclusion from the atmosphere.

ANIMAL HEAT. The caloric constantly formed by the body of a living animal, by virtue of which it preserves nearly the same temperature, whatever may be that of the medium in which it is placed. All those animals which possess the greatest variety of organized parts, and whose functions are the most perfect, possess the power of maintaining their temperature at a uniform standard, and one considerably above that of the atmosphere. The temperature of birds is the highest; that of man and the mammalia is about 38°, and these experience little alteration, except near the surface; while fish and reptiles possess what is called *cold blood*, being of a variable temperature, only a degree or two above that of the media in which they are immersed.

The subjects of inquiry respecting animal heat, are, 1. What is the cause or source of it? 2. By what means is its uniformity preserved? To

which we may add, in the 3d place, How is the body cooled, when placed in a temperature higher than that which is natural to it?

Independent of direct experiment, there are many circumstances connected with animal temperature which would lead us to conclude that it is intimately connected with the function of respiration. In the first place, all animals that have a temperature much superior to that in which they are immersed have their lungs constructed in the most perfect manner, and possessing the most elaborate organization; while there is an obvious relation between the quantity of oxygen which they consume and the heat which they evolve. Thus, what are styled the warm blooded animals, have lungs of a large size, and so formed as to permit the blood and the air to exercise the most extensive influence over each other. In amphibia, the pulmonary vessels of the lungs are much more scanty: while the circulation is so arranged, that only a part of the blood passes through them during each circulation. The temperature of these animals is proportionably low; and in fish, where there is only a small quantity of blood to receive the action of the air, and that in a less direct manner, the temperature is only a degree or two above that of the medium in which they live. In the second place, it is observed, that, in the same species of animals, or even in the same individual under different circumstances, whatever quickens the circulation raises the temperature; and that, when the respiration is impeded, either from disease or from an original mal-conformation of the organs, the temperature is proportionably lowered. Lastly, it may be urged in favour of the chemical theory of animal heat, that oxygen is actually united to carbon; and that, according to the ordinary effect of this union, caloric must be liberated, so that it would be difficult to explain how it is disposed of, if it be not employed in raising the temperature of the body. There is also a farther circumstance to be held in view, that, if we reject the hypothesis of the lungs being the source of animal heat, we have no other adequate cause for its production; for, although some writers have supposed that the stomach, and others that the nervous system is concerned in this function, yet these have been thrown out as mere conjectures, without being digested into any regular system, so as to point out, in either case, in what manner the effect follows the supposed cause. Upon the whole, therefore, we think ourselves warranted in concluding, in the present state of our knowledge upon the subject, that animal heat is derived, in the first instance, from the union of oxygen and carbon, which takes place in the lungs during the process of respiration.

If we have found it difficult to arrive at any certain conclusion on the first point that we proposed to discuss, we shall probably find it still more so with respect to the second—By what

means is the uniformity of the animal temperature preserved? because any speculation which we may form upon this subject must, in a great measure, depend upon our ideas of the means by which animal heat is produced. With the general fact we are well acquainted, that, in warm-blooded animals, each species has a temperature that is natural to itself, from which it deviates very little while in its healthy state. The temperature of the internal parts of the human body is between 98° and 99° ; and this temperature is preserved with as much regularity by the Greenlander as by the African. There are, no doubt, many circumstances in their modes of life by which the inhabitants of these different regions endeavour to counteract the extremes of heat and cold to which they are exposed; but after making allowance for all these circumstances, some system of adjustment of the functions will be necessary in order to preserve that uniformity of temperature which is so essential to life.

The experiments of Priestley and Crawford, which first threw some light upon this intricate subject, were repeated and considerably extended by Lavoisier. They led to the same conclusion, that the union of oxygen and carbon in the lungs is influenced by the temperature of the inspired air; the lower the temperature the more tendency there is to their union, there is a greater consumption of oxygen, and a more rapid generation of carbonic acid. Hence, according to our usual notions upon this subject, there must be a greater evolution of animal heat; and this will naturally have the effect of counteracting the lower temperature in which the body, in this case, is conceived to be immersed. According to Crawford's theory, the greater quantity of carbon is removed from the blood, the more perfectly is it converted from the venous to the arterial state, the more is its capacity for heat increased, and the more will it require to supply this increased capacity, which will be afterwards liberated during the course of the circulation to maintain the due temperature of the body. Although this explanation proceeds in part upon the principles of Crawford's theory, and may be so far considered as of doubtful authority, it depends, to a certain extent, upon the direct results of experiments that were performed without any view to this hypothesis, and which appear to be entitled to our confidence; while, it must be admitted, that the admirable manner in which they explain the phenomena, affords at least some presumption of their truth. But although the experiments that have been performed are favourable to the hypothesis—that the formation of carbonic acid in the lungs is so regulated by the temperature of the air as to produce heat according to the demand for it in the system—still they are not sufficiently numerous or decisive to amount to a demonstration of its truth. Should it be confirmed by subsequent facts and experiments, it must be admitted to be one of the most beautiful examples of the adapta-

tion of means to ends that is to be met with in any part of the animal economy.

It was an opinion generally received among the older writers, and it was maintained even by Boerhaave, that life cannot exist in a temperature higher than that which is natural to the body: but many facts have been lately brought to light which completely disprove this position. The first of them, which rested upon good authority, was communicated by Tillet and Duhamel. They gave an account of some young women, in the service of a baker, in one of the provincial towns in France, who were accustomed to enter the hot ovens for the purpose of turning the loaves; and this, it was said, was done without any apparent inconvenience, provided they were careful not to touch the heated surface. The narrative was scarcely credited at the time, but subsequent facts have fully established its credibility. A set of experiments were performed in London, by Blagden and Fordyce, in which a chamber was heated to a temperature higher than that of boiling water, and these gentlemen found that they could easily remain in it for an indefinite length of time. It is, however, to be regretted, that they almost exclusively directed their attention to the effects of the heated air upon the various substances in the room, and unfortunately neglected to observe its action upon the living body itself. We are, indeed, informed that they perspired very copiously, but we have no information respecting the most important point, whether their temperature was actually raised; or, at least, what we are told on this subject is too vague to allow us to place much confidence in the statement. Some experiments have been lately performed by M. De la Roche which give us some insight into this intricate subject. He found that the body was capable of remaining in a temperature considerably higher than that which is natural to it, as long as there was a free access to the surrounding air; but that, when the animal was confined in a small space, an uneasy sensation was produced, and the temperature was elevated. Hence it may be conjectured, that the evaporation of aqueous vapour from the lungs, and perhaps also from the surface of the body, is the means by which the superabundant heat is carried off in these cases, so as to form a kind of balance to that operation, whatever it be, by which heat is generated under ordinary circumstances.

There is, however, much left for us to inquire into in this process. In the first place, we have to ascertain, to what degree a mass of matter, of the same capacity with the body, and of equal bulk, would have been heated at the same temperature with that to which the individuals were exposed in the above experiments. We know, that when air is much heated, it is proportionably rarefied; fewer particles of it, therefore, come into contact with the cold body, and hence the communication of heat will be much slower.

Then, with respect to the animal functions taken in connexion with each other, we should examine what effect the respiration has, in these cases, upon the air taken into the lungs; is there any carbonic acid formed? and, if there be, what quantity is generated? We should be led by analogy to suppose, that the amount of oxygen consumed must be very small, so that the usual supply of heat would be cut off. Our next object should be, to discover whether the quantity of aqueous vapour discharged from the lungs would be sufficient to counteract the operation of all the sources, either internal or external, by which the body acquires heat, and we should then be able to decide upon a point which has been much agitated, whether there be any specific function for the purpose of cooling the body, or rather, whether the evaporation of the cutaneous and pulmonary vapour be alone sufficient for that purpose. There has been much vague speculation employed by physiologists, on the power of the body in generating cold. No part of the animal economy has been treated of in a more mysterious manner, and different metaphysical notions have been formed to account for an operation, the existence of which has not yet been satisfactorily proved. What, however, we do know upon the subject, seems to warrant us in pointing out this part of the animal system, as an additional example of that beautiful adjustment of the functions to each other upon which we have already taken occasion to remark; for it appears, that not only have the lungs the power of evolving heat in greater or less quantity, in proportion to the demands of the system, but that the same organ, when necessary, can even produce the contrary effect, and generate cold.

ANIMAL MANURES. The excrements, flesh, bones, hair, wool, or putrescent products of animals, employed as fertilizers of the soil. These substances act a highly conspicuous and most valuable part in the practical chemistry of agriculture; and, as to at once their differences from one another, their several chemical constitutions, and their respective modes of action both separately and in mixture, they ought to be thoroughly known by every farmer. Yet we cannot treat them at length as a separate topic, but must restrict ourselves to some general remarks upon them, particularly upon animal excrements, and must refer, for a full view of them, to our articles MANURES, FARM-YARD MANURE, LIQUID MANURE, NIGHT SOIL, URINE, GULL, OIL, OIL-CAKE, BONES, GUANO, FISH, GEINE, POUDRETTE, AMMONIA, AZOTE, and some others.

The excrementitious matter of animals is partly solid and partly liquid, the former passing through the intestinal canal, and the latter through the urinary passages; and the solid kinds are habitually more or less dense, or more or less mixed with water, in the proportion in which the species of animal uses more or less of liquid

nourishment. The *feces* or solid excrements consist of undigested or ill-digested remains of vegetables, alkaline and earthy salts, and oxides derived from vegetable food and water, refuse secretions from the animals' own bodies, and some peculiar compound substances formed partly out of their food, and partly out of their refuse secretions; and urine or liquid excrement consists principally of water holding in solution mucus, albumen, urea, uric acid, hippuric acid, ammonia, and various kinds of salts and other substances. The several matters hitherto detected by chemical analysis in animal excrements are water, vegetable or woody fibre, wax and resin, chlorophyle or the green colouring matter of leaves, deposited humus, a fatty substance, mucus, a peculiar brown colouring matter, vegetable albumen, animal gelatine, animal fibre, salivary matter, osmazome, hippuric acid, uric acid, lactic acid, benzoic acid, urea, bilious matter, bilious resin, picromel, oxide of iron, oxide of manganese, silica, alumina, magnesia, common salt, various alkaline salts, ammonia, hydrogen, carburetted hydrogen, phosphuretted hydrogen, and sulphuretted hydrogen. But chemical analysis of excrements is so very vile and repugnant a process, that few will attempt it in any form, and even these few in but a slovenly manner; and were it carefully and searchingly conducted, it would very probably detect many more substances, particularly of the unique kind which are formed in the interior organism under the combined agencies of organic chemistry and animal life.

The composition and the manurial value of animal excrements are greatly modified by the age of the animals, their kind, their mode of employment, the quality and quantity of their food, and the quality and quantity of their drink.—A considerable quantity of lime, nitrogen, and phosphoric acid is required for the formation of the bones of young animals, and of carbon, sulphur, chlorine, and soda, for the growth of their bodies; and as these substances are obtained only from food—which generally is of the same nature when the animal is young as when it is adult—the proportion of them in the excrements of young animals must be considerably less than in those of old animals. Manure from young stock, accordingly, has long been known to farmers to be much inferior in power to manure from adult stock; and, on account of its deficiency in nitrogenous ingredients, it is peculiarly ill suited for crops of wheat, barley, beans, clover, and turnips.—Some kinds of animals secrete certain elements of food which others reject; some masticate their food into a state of much finer trituration than others; and some very thoroughly digest their food, while others only half-digest it; and hence two animals of different species, fed on the same food, and in the same situation, yield excrementitious manures of widely different composition and power. Cows require,

for the chemical constitution of their body or for the formation of their milk, more nitrogen and phosphate of lime than sheep; and sheep require, for the formation of their wool, more sulphur and common salt than cows; so that if a cow and a sheep be fed on the same pasture, the excrements of the former will contain an excess of sulphur and salt, and those of the latter an excess of nitrogen and phosphate of lime. Sheep both chew and digest their food much more thoroughly than cows, reducing it to a state of much finer attrition in the mouth, and extracting from it a much larger proportion of nourishment in the intestines; and hence, when a sheep and a cow are fed on the same pasture, the excrements of the former will operate more rapidly on the soil than those of the latter, but will exert much less manurial power, and operate for a considerably shorter period.—When animals are so poorly fed as to lose flesh, they very thoroughly digest their food; but when so well fed as to become fattened, they secrete but a portion of the nutritious matter which they eat; so that their excrements in the former case are poor and exhausted, and in the latter case are very strong, and contain much of the elements of nutrition and much refuse animal matter. The more nutritious the food is, provided it be in quantity and condition to fatten, the stronger are the excrements resulting from it, and the more do they abound in the important elements of phosphorus, sulphur, soda, potash, chlorine, lime, magnesia, and nitrogen. Excrement from scalded food for oxen, in consequence of the woody fibre and other hard vegetable matter having been softened by the process of scalding, will operate more quickly upon soil than excrement from unscalded food, but will exert a much inferior amount of manurial power. The free use of common salt in the food of fattening stock occasions a great increase in the fertilizing power of their excrements; and a plentiful use of pond or river water by any species of animal involves a considerable increase in the saline elements of manure. An ox daily drinks eighty pounds or upwards of water; and this quantity of most kinds of pond or river water contains from half an ounce to an ounce of saline matters, consisting of gypsum, common salt, phosphate of lime, carbonate of lime, carbonate of potash, and carbonate of magnesia; so that, in the course of a year, about sixteen pounds of these saline matters, obtained from drink and discharged by excrement, are supplied by an ox to a statute acre of land. A sickly animal, in consequence of impaired digestion, usually yields stronger manure than an animal in perfect health; and animals in summer, in consequence of enfeebling heat and relaxed muscle, usually yield stronger manure than during the braced nerve and robust health enjoyed in winter. Animal excrements may always be regarded as great in manurial power when they pass quickly into the putrefaction state, and develop a large quantity of pun-

gent and offensive gases; for then they are rich not only in sulphur, phosphorus, and nitrogen, but also in chlorine, soda, potash, lime, and magnesia; and therefore are eminently fitted to restore the fertility of exhausted soils, or to qualify land for producing wheat, barley, beans and other albuminous crops. The specific excrementitious manure of cows, sheep, horses, and other animals, will be noticed in the articles **EXCREMENT** and **URINE**.

The flesh and intestines of quadrupeds are sometimes used as manures; and as they undergo a rapid and very wasteful and offensive decomposition when exposed to the open air, they ought when fresh to be either covered with the soil, or mixed up with earthy substances into a compost. The refuse of shambles is always a powerful manure, and ought when fresh to be mixed up with earthy matter for a compost; and the carcasses of domestic animals, which die from accident or disease, ought, immediately after death, to be laid in shallow pits, covered with earth containing a mixture of quicklime, allowed to dissolve in that position, and afterwards treated with the surrounding soil as a compost. Blubber may be very beneficially employed as a manure, and ought always to be formed into a compost with earthy matter. The garbage of sea-fish is an efficient manure for every kind of crop, and may be obtained in considerable quantity in fishing villages where fish are smoked or salted. Herrings, in some years of great plenty, have—wickedly, as we think—been fished in such enormous quantities as to be sold profusely in cart-loads to farmers as manure. Fresh-water fish are sometimes obtained in sufficient quantity, in the shallows of fenny countries, to be employed as manure; and, though of very questionable propriety, they have confessedly a very high manurial power. Sprats for manure, are purchased in thousands of bushels at a time by the farmers of Essex and Suffolk, and are carried in waggons to districts ten or fifteen miles distant from the coast; and when mixed with earth, allowed to dissolve, and used as a compost, they operate with great power, especially upon turnips, yet expend nearly all their force upon a single crop. Woollen rags, chopped small, and strewed along the drills in the proportion of 3 or 4 cwt. to an acre, are an excellent manure for potatoes, but are employed chiefly for hops; and they are known to be used by English farmers to the aggregate amount of 20,000 tons a-year, and obtained at so high a price as five guineas per ton. Various other animal substances,—the refuse of manufactories in which wool, skin, feathers, and hair are employed,—such substances as the refuse of the currier and the offal of the gluemaker—are used in the same manner, or upon the same principle, as woollen rags. Bones are so efficient, well-known, and generally used a manure, as to demand lengthened notice in an article of their own. See **BOXES**. Horn is a substance of similar

properties to bones, and equally efficient as a manure; but it can be obtained in only very limited quantity, and, on that account, is of inferior importance. Hair and feathers are also similar in chemical composition to bones; but, for the same reason as horn, they never can make a prominent figure among manures. The remains of the silk-worm are employed by the inhabitants of silk-producing countries, as manure for reviving the mulberry tree and stimulating some other plants. The pulverized shells of oysters, mussels, and other shell-fish, is used as manure for turnips; but it possesses only about half the manurial power of bones; and is frequently employed by nefarious venders as a means of adulterating bone-dust. The common shells of the shores of Great Britain, such as those of cockles, whelks, and mussels, are found in large quantities upon some rocky districts of coast, and upon shallow beaches which are swept by powerful tidal currents; and, when applied in the proportion of sixteen bushels per acre, they act as a very suitable manure for turnips. All animal substances whatever, no matter how completely of the nature of waste or offal, or how apparently unlike in nature to the more common manures, act upon the soil as fertilizers, and may be beneficially employed either singly or in composts. The principal in use, additional to those which we have named, are various kinds of oils and oil-cakes, animalized black, animalized sea-weed, cockchafers, dried muscular flesh, blood in various conditions, dregs of bone glue, and cow-hair flock.—*Paper of Dr. Sprengel in Journal R. Agr. Society.*—*Boussingault's Rural Economy.*—*Johnson on Fertilizers.*—*Dr. Dana's Muck Manual.*—*Armstrong's Treatise on Agriculture.*—*Liebig's Organic Chemistry.*—*Johnston's Lectures on Agr. Chemistry.*—*Low's Practical Agriculture.*—*Sproule's Treatise on Agriculture.*—*Stephen's Book of the Farm.*

ANIMAL OAT. See **OATS**.

ANIMAL POISONS. See **POISONS**.

ANIMAL POWER. The exertion of the strength of animals to produce motion or physical change. The principal varieties of this upon a farm are the several kinds of horse labour, in moving implements, vehicles, and machinery. Animal power has been principally or wholly superseded by mechanical power, chiefly that of the steam-engine, on railways and in multitudinous manufactories; it has also been partially superseded by mechanical power on the farmery of large farms; and it has, of late years, been frequently threatened by theorists with being superseded by mechanical power in almost every department of agricultural labour. But animal power may easily be shown to possess important adaptations to farm labour, which mechanical power does not possess, to be free from some serious objections with which the use of mechanical power is encumbered, and, in particular, for all the ordinary purposes of draught upon farms or of traffic upon common roads, to be at once sim-

pler in its application, more economical in its use, and more certain in its effect. In all cases, indeed, in which considerable velocity is required, the power of a horse may be principally or wholly exhausted in moving his own body, and, when the road is level and smooth, must necessarily be far inferior to the mechanical power of a steam-engine. But in every case in which great velocity is not an object, and in which frequent though slight obstructions occur, the power of a horse possesses very decided advantages. He admirably adapts himself to the peculiarities of his work, increases or diminishes his efforts according to the variations of his draught, rests and reinvigorates himself by relaxed exertion when his utmost strength is not needed, and makes extra-exertions or summons up his husbanded force when any impediment or obstruction is to be overcome. In fact, by his alternations of comparative relaxation and comparative over-exertion, he probably expends more aggregate strength than when, as on a perfectly level railway and at an uniform rate of speed, he constantly uses his average degree of power; and if it be remembered that on most ordinary roads, obstructions and facilities occur in continual succession, and the rate of draught often varies in the proportion of six or eight to one, the horse's accommodating faculty of alternating the degrees of his strength to the alternations in his draught will be seen, at a glance, to possess high value for the rugged labours of a farm, and such as, in the present condition of mechanical science, cannot be profitably or almost possibly superseded by the steam-engine. The relative strength of horses, asses, and men, has been estimated as follows:

- | | |
|----------------------------|----------------|
| 1 horse is equal to 5 men, | { Desaguliers. |
| 1 7 men, | { Smeaton. |
| 1 14 men, | { Bossut, &c. |
| 1 ass 2 men, | { Schulze. |
| | { Bossut. |
- 2 horses, according to Amontons, exert a force of 150 pounds when yoked in a plough.
- 1 horse, according to Desaguliers, can draw with a force of 200 lbs. $2\frac{1}{2}$ miles an hour, and continue this action for 8 hours every day. When he exerts a force of 240 pounds, he can continue it only 6 hours every day.
- 1 horse, by means of pumps, can, according to Mr. Smeaton, raise 250 hogsheads of water 10 feet high in an hour.
- 1 horse walking on a good road, and loaded with about 2 hundred weight, can travel 25 miles in 7 or 8 hours.
- 1 horse raising coals by means of a wheel and axle, and moving at the rate of about 2 miles an hour, can, according to Mr. Fenwick, raise a load of 1,000 pounds avoirdupois with a velocity of 13 feet per minute, and continue this for 12 hours.
- 1 horse, according to the same author, can exert a force of 75 pounds, moving at the

rate of 13 feet per minute, and continue it for $9\frac{1}{2}$ hours.

According to Regnier, the mean draught of 4 horses was 36 myriogrammes in 794 hours.

1 horse can draw more up a steep hill than three men can carry; that is, from 450 to 750 lbs. Desaguliers.

1 strong horse can draw 2,000 lbs. in a cart, up a steep hill which is but short. Desaguliers.

1 horse has sometimes carried 650 or 700 lbs. for 7 or 8 miles without resting, as its ordinary work. Desaguliers.

1 horse at Stourbridge carried 11 hundred weight of iron, or 1,232 lbs. for eight miles. Desaguliers.

1 mule works in the West Indies, 2 hours out of about 18, with a force of about 150 lbs. walking 3 feet in one second. Cazand.

From Desaguliers' measure of the force of a horse already given, it follows that its force is,

	Pounds.	Foot.
According to Desaguliers, 44,000 raised	1	in 1 min.
According to Smeaton, 22,916 .	1	in 1
According to Mr. Watt, 33,000 .	1	in 1

Mr. Watt's steam-engines are, however, calculated to work equal to 44,000 lbs. raised 1 foot per minute, as he considers the difference, or 11,000 lbs. raised 1 foot per minute, to be lost in the friction, &c. of the engine itself.

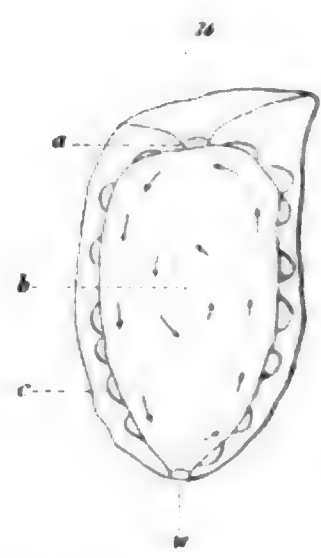
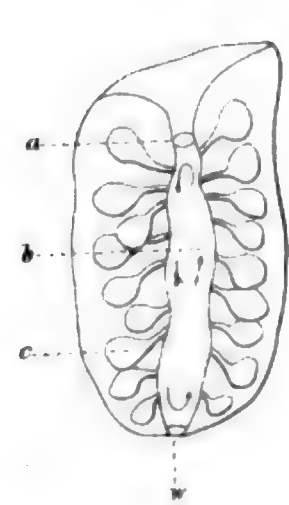
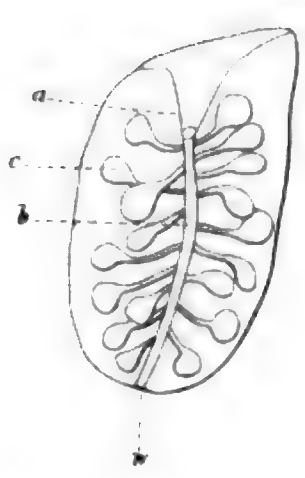
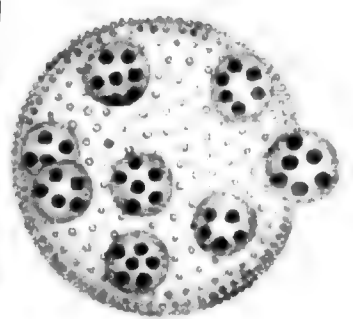
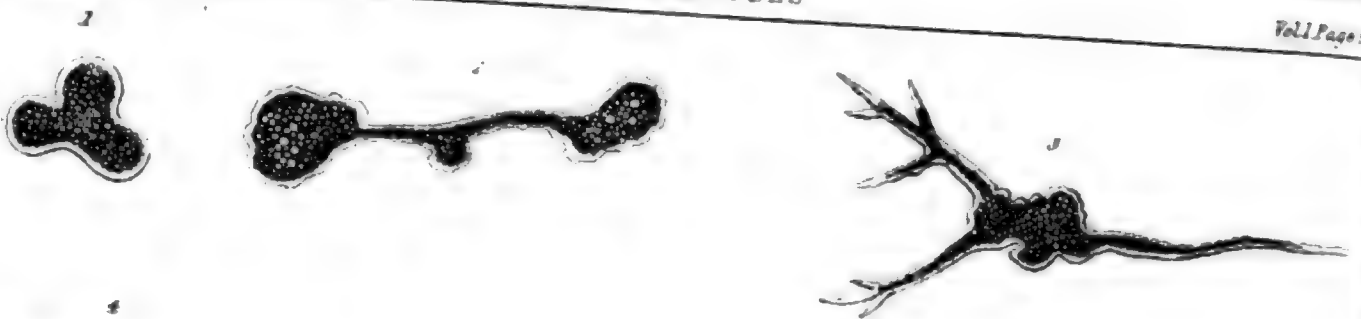
The power of one horse is supposed capable of driving 100 spindles with preparation of cotton water-twist, 1,000 spindles with preparation of cotton mule yarn, and 75 spindles with preparation of flax yarn.

The following are the results respecting horses given by M. Hachette:

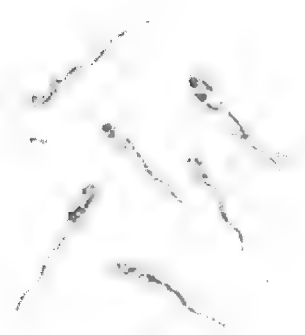
	Kilog.	Kilom.	Daily action measured by the draught and the road travelled.	Useful effect in Dynamical Units.
1. A cart-horse 140×40 .			5,000	
2. A post-horse 90×38 .			3,420	
3. A horse moving in a circle and working a pump, .				585
4. Id. working 12 hours, and raising plaster, .			1,684	842
5. Mean of three horses working at a pump, .			1,185	595
6. Mean of 8 horses raising water by a pump, .			2,948	675
7. Two horses raising coals, .				1,560
8. A horse drawing a load of 150,000 kilogrammes through 8 kilometres, .			800	Doubtful.
9. The force of a horse acting 24 hours, is equal to .			5,974	dynam. units.

See articles DRAUGHT, FORCE, FRICTION, HORSE, and STEAM-ENGINE.

ANIMALCULE. In its literal and general sense, this term signifies a very small animal; but it is commonly used to denote one so minute that its form and parts cannot be distinguished without the aid of a microscope. Linnæus placed these minute animals in a genus which he denominated chaos, in the last order of his class



1
2



Vermes. O. F. Müller, and after him, Gmelin, made a distinct order of them; and as the greater number of the species which Müller investigated were found in liquids in which vegetable or animal matters had been infused, he gave them the name Infusoria. Dr. Ehrenberg of Berlin—who has contributed more than even Müller himself to our knowledge of the infusory animalcules, having up to 1835 examined 722 species—regards all true Infusoria, even the smallest monads, as organized animal bodies, provided with a mouth and internal nutritive apparatus; and he separates the genera *Cercaria* and *Vibrio* from the true Infusoria, because these genera have neither internal stomachs, nor external cilia. Many naturalists deny the existence of an alimentary canal in Infusoria; but Ehrenberg stoutly maintains it, and also that of a respiratory system. At times, he says, the intestinal canal of the animalcule extends, at the expense of the ventral sac, so far that it occupies the whole space of the body. In *Plate III., Figs. 13, 14, and 15* are ideal figures of the *Lorodes bursaria*, in various states of the extension of the alimentary canal, and its inner circular motion: *a* marking the mouth; *b*, the alimentary canal; *c*, the ventral sac; and *w* the anal aperture.

There is no certain law with regard to the peculiar species produced by any particular infusion. In general, several different species will be exhibited, which disappear, and are succeeded by others; and sometimes, where there are myriads of one kind, a single solitary animalcule of a remote genus is found among them. Vinegar is full of minute eels, which are also found in paste. Müller conceives that the sea abounds in animalcules peculiar to itself; and Spallanzani observes that vegetable substances, dissolving in sea-water, produce swarms of animalcules. It is possible, that, on carefully attending to the different seasons of the year, the existence of various species of animalcules may be found dependent on them. The red snow of the Arctic regions is now known to receive its colour from the presence of myriads of animalcules; and green snow owes its colour to the same cause: the granules being red when young, and green when old.

The extraordinary minuteness of animalcules surpasses the conception of the human mind. Leeuwenhoek calculates that the size of some is to that of a mite as a bee is to a horse; an hundred others will not exceed the thickness of a single hair; and ten thousand of a different species may be contained in the space occupied by a grain of sand. Ehrenberg has described species so minute that a single drop of water may hold 500,000,000.

The shapes of animalcules are infinitely diversified. Let one suppose himself transported to a region where the appearance, figure, and motion of every animal is unknown, and he will form some idea of the variety presented by a drop of an infusion presented to the microscope. One animalcule is a long slender line; another is coiled

up like an eel, or a serpent; some are circular, elliptical, or globular; others present the form of a triangle or a cylinder; some resemble thin flat plates, and some may be compared to a number of articulated reeds; one is like a funnel, another like a bell; and the structure of many cannot be compared to any object familiar to our senses. Certain animalcules, such as the *Proteus diffuens*, *Plate III., Figs. 1, 2, and 3*, can change their figure at pleasure; being sometimes extended to immoderate length, and then contracted to a point. One moment they are inflated into a sphere, the next completely flaccid, and then various eminences will project from the surface, altering them apparently into animals entirely different. Neither is the peculiar motion of animalcules less remarkable. In several species, it consists of incessant gyration on the head as a centre, or around a particular point as if one of the foci of an ellipse. The progression of others is by means of leaps or undulations; some swim with the velocity of an arrow, the eye can hardly follow them; some drag their unwieldy bodies along with painful exertion; and others again seem to persist in perpetual rest. These observations lead to consideration of the inconceivable minuteness of the organs, and the component parts of these organs, by which such motions are performed.

The food of the different species of animalcules is not yet indisputably ascertained: probably it consists both of animal and vegetable matter; and they also prey on each other. The latter circumstance, indeed, has been denied; for it is maintained by several authors, that, if the vortex which many are endowed with the faculty of creating in the fluid, does engulf other animalcules along with vegetable substances, the former are rejected and escape in safety. Other authors maintain the opposite opinion with equal confidence. Leeuwenhoek, in speaking of the Wheel animal, indicates his belief of this fact. Ellis says the same of an animalcule denominated by him *Volvox vorax*. Goeze has seen the *Trichoda cimer* devour the lesser animalcules voraciously; and Spallanzani, speaking of this subject, observes that animalcules feed so greedily upon each other as to become larger, and prove indolent and sluggish. On the contrary, if reduced to abstinence, by being kept in distilled water, they are full of spirit, and eagerly devour the minuter animalcules supplied to them; while the transparency of their bodies allows us to perceive their prey, still retaining motion after being swallowed. Baron Gleichen, in 1781, tinged water with carmine, and mixed it with an infusion. On the second day, the internal colour of the animalcules showed that most of them had swallowed part of the liquid. Dr. Ehrenberg, by diffusing pure indigo in the water which contained them, was enabled by observing the progress of the coloured particles through their transparent bodies, to arrive at certain conclusions respecting their anatomical

structure; but doubts have latterly been thrown over his views by several accurate observers. M. Neyer says he never admitted the observations of M. Ehrenberg, because, in the first place, "I never could see the intestines which form the communication between the stomachs, and likewise because I have observed, many years since, that the supposed stomachs were moving in the interior of the body of many species with great rapidity, in the same manner as the granules which circulate in the joints of the *Chara*. I have often seen *Vorticellæ* with nine or ten large globules of indigo in the belly, which always moved round a centre, and thus showed in the most evident manner that they could not have a communicating canal between the stomachs provided with an oral orifice and an extremity directed to the mouth." M. Meyer considers that the inner surface of the first part of the canal is provided with cilia, which roll up alimentary and colouring matters into the form of a ball. When the ball has acquired the size of the stomach, it is expelled by its other extremity and pushed into the cavity of the animal. If solid substances do not exist in the surrounding liquid, then the balls are less solid, and appear in the forms which they present in the *Infusoria* existing in colourless liquids. "In this case the balls are composed of a small number of particles, and principally of a considerable mucous mass which unites them."

Of all the peculiarities by which animalcules are distinguished, those which respect their propagation are the best deserving of attention. The concourse of the sexes is required to perpetuate the species among the larger animals; but, on descending the scale, some are found which individually possess the characteristics of both sexes united in themselves, though their concourse is still required. In some, such as fishes, each possesses the sexual organs of the male or female; but instead of their concourse, external fecundation takes place; others again, such as the animal-flower and polypus, are strictly hermaphrodites; and all produce their young without actual fecundation. The *Infusoria* propagate by eggs, by living foetuses, and by a portion of the body being detached from the body of the parent. Many species are undoubtedly hermaphrodite. Ehrenberg has calculated the fertility or capacity of increase of microscopic animals to be so great that an imperceptible corpuscle can become, in four days, 170 billions, by gemmination or voluntary division.

There is a species of animalcule formed in infusions of hemp seed, which is described by M. Bonnet, as provided with a beak, or hook, at the anterior part. When an animalcule of this species is about to divide, it seeks a convenient place at the bottom of its infusion,—commonly among that semi-transparent kind of mucilage which is formed in that of hemp seed. After searching and examining various places, it at last fixes on

one; the body, which is naturally long, contracts; the curved beak is retracted or concealed, and the animal assumes a spherical figure. It next begins to revolve on itself, so that the centre of motion is fixed, or the sphere never changes its place. The motion is performed with the most perfect regularity, but the direction of rotation is constantly changing, in such a manner that the rotation may be first from right to left, then from before, and next from left to right; and all these changes are perfectly performed, without the animalcule or rotatory machine changing its place. At length the motion accelerates, and at the point where the sphere seemed motionless, two cross divisions begin to be visible, exactly like the husk of a chestnut ready to burst. In a little longer, the animal appears agitated and making great exertions; at last it divides into four parts, each the same as the producing animalcule, but smaller. These grow larger, and each divides again into four, which in their turn increase and become equal to the parent,—if the word parent may be used in respect of this singular mode of generation.

Propagation, by division of the body, is not confined to the more simple animalcules; it extends to those of complicated structure, such as the *Vorticellæ*, to which genus the one we have just described probably belongs. The *Vorticellæ* are so denominated, from their power of creating a vortex in the fluid which they inhabit, by means of a circular row of fibrilli proceeding from the head or anterior period; and the floating particles in the infusion, being absorbed, the animal can select its food from among them. The *Vorticellians*, *Plate III., Fig. 4*, propagates by a longitudinal division of the body. The figure of this animal resembles a ball, to which a filament or tail is attached. Previous to the commencement of division, the anterior part appears languid; then a small cleft is seen in it, which gradually increasing, each portion exhibits a mishapen animalcule. As the separation advances, the figure of each becomes more perfect, the division is at length completed, and both become entire and well-formed animals. The filament, however, belongs only to one; the other acquires it. When the division is almost perfected, each part forms its own peculiar vortex, in points diametrically opposite.

Several of the *Vorticellæ* resemble a plant in miniature, consisting of a stem putting forth numerous branches and twigs, each terminated by a bell on its fibrille, which forms the active part of the animal. Every bell, with its filament and fibrilli, has a spontaneous motion independent of the rest; by alternate contraction and extension it can approach and recede from the stalk or branches, as in the *Vorticella convallaria*, *Fig. 6*. Sometimes the whole will instantaneously close into a minute, round, white speck, at the root where it fixes, and again as instantaneously expand into a perfect tree. The common

stem may be detached at pleasure, and then the entire animal swims through the fluid, with its numerous filaments, bells, or fibrilli—often exceeding an hundred—in motion; each forming its own peculiar vortex to absorb its food: thus presenting a singular and interesting spectacle, of which it is difficult to convey an adequate idea by description. The *Vorticella pyrraria*, Fig. 5, resembles a shrub, with numerous ramifications, each terminated by an animalcule. During the progress of propagation, two animalcules are found at the extremity, instead of one; or, if any appear single, they are marked with a slight furrow which indicates incipient division. Each produces two, then four, eight, sixteen, and thirty-two animalcules. Spallanzani describes his observations on one of these Vorticellæ. It resembled a tree in miniature; numberless branches dividing into smaller ones, proceeded from the trunk; these divided into others successively less, and each of the smaller bore a bell at the extremity. Every three or four seconds, the trunk unexpectedly contracted towards the base, and instantaneously drew in all the branches, twigs, and animalcules, but in a moment restored the tree complete, with all its animals, to the original state. During the course of an observation, the ramifications of the plant had so much extended, and the numbers of the animalcules so much increased, that its circumference was tripled: but the supervening death of the animalcules occasioned that of the plant. They began to fall from the branches, as fruit falls from the tree, and, as they gradually separated, the motive power finally was lost. Spontaneous extension and contraction were no longer seen; the vibration of the fibrilli, or the attending vortex; each animalcule became disfigured and was destroyed. The plant lived while the animalcule formed a part of it; after that its vegetation was at an end, its motion ceased, and death ensued.

The *Volvox globator*, Fig. 7, is a globular animalcule, of a greenish colour, visible by the naked eye. It is frequently found in the water of ditches, and marshes abounding with growing vegetables, as well as in those in a decomposing state, and often in considerable numbers. Its mode of progression through the fluid is by revolving on itself, or rolling like a sphere; whence its name has been derived. This animalcule consists of extremely transparent membranaceous substances, containing minute globules, irregularly dispersed within it. On examination with a very powerful magnifier, the globules appear so many young Volvoxes, each provided with its diaphanous membrane, and within that again is involved another race of descendants. When the Volvoxes have attained a certain maturity, the included young begin to move, detach themselves from the parent, and, successively escaping from the investing substance, swim about in the infusion. When all have left it, the common envelop, or mother, becomes motionless, bursts, and

disappears. Then the new volvoxes rapidly increase in size; their included globules likewise grow, they begin to move, the parent bursts, and the young swim at large in the infusion. By isolating these animals in watch-glasses, the thirteenth successive generation, from a single parent, has been obtained.

Such are some of the more remarkable methods by which the race of those minute animals is perpetuated. But the dangers to which they are exposed infinitely exceed those attendant on the larger animals, not only from the noxious quality imparted to infusions, but from evaporation, which is destructive to myriads beyond the power of calculation to reach. Independent of those that die in giving existence to their young, they are, like other animals, subject to instantaneous death. According to Müller, several of the larger species are destroyed and totally dissolved by simple contact with the air. Some he has seen decomposed on approaching the edge of a drop; and others, amidst the rapidity of their course, have been dissolved in a moment. Too much heat and cold are alike fatal to them: they die at a degree of heat between 106° and 111° ; and if the liquid which they inhabit freezes, it kills them. But if by any means its fluidity can be preserved, they will not be destroyed below the cold of 12° , or even 20° , under the freezing point. The Anguillæ of vinegar can endure a still greater degree of cold. Dr. Power remarks, that the vinegar may be frozen and thawed several times, and they will still be as lively as ever.

But some animalcules seem to enjoy a privilege denied to the rest of the animated creation: they can be revived after death. So singular and unaccountable a property merits the deepest consideration. Nor is this wonderful prerogative confined to the momentary interruption of life: it succeeds—so far as we hitherto know—though the vital functions have been suspended for an unlimited length of time. In recurring to analogies, we find, that there are many animals, quadrupeds, serpents, and chiefly of all insects, which are reduced to a state of torpidity by the simple approach of cold, without any other operative cause: their motion ceases, their members stiffen, and they are absorbed in a profound sleep, from which they can be aroused by the application of heat alone. But this lethargic state is widely different from that of death, though that will be its termination if too long protracted. Perhaps this may also be the case with those animalcules of which we treat; and if the state into which they are brought be not real and absolute death, in the most rigorous sense of the word, or that which allows the animal substance to decompose, too long suspension of the vital functions, without renewing them by resurrection, may be alike fatal in its consequences. The Wheel-animal, or *Vorticella rotatoria* [Figs. 8 and 9], of systematic authors, is one of the animalcules enjoying this admirable prerogative in the most

distinguished degree. It was first discovered by Leeuwenhoek, in 1702, and has since been frequently the subject of observation by other naturalists, from whose investigation it appears that the singular faculty of resuscitation is extended to several species of this animal. It is difficult to describe this animal while living, from its perpetual change of shape. Sometimes it is protracted into extreme slenderness; then it is inflated into a short, corpulent figure; one half of the organs composing the whole will next be concealed, while the other is seen in its full size and figure. The Wheel-animal fixes itself by means of a point at the one extremity or tail, which, if viewed by a powerful magnifier, is found to consist of a number of smaller points: and from the other extremity or head two organs proceed, resembling wheels, which, by a rapid motion that they are susceptible of, produce a vortex in the surrounding fluid. These organs are not exactly of the same description in all Wheel-animals: in some they are circular, in others semicircular, or even of a more irregular figure. Filaments, or fibrilli, of various length, according to the different species, proceed from them, similar to those that we have already said occasion a vortex, for the purpose of supplying animalcules with their food. According to the opinion of several of the most acute observers—among whom is Leeuwenhoek—the vortex is produced by the actual revolution of these organs, as of two mechanical wheels; and they describe this revolution as not always proceeding in the same direction, but first from right to left, then from left to right, and so on alternately. When the water containing the Wheel-animal evaporates, it becomes languid and inactive, the motion of the wheels is interrupted, they are retracted within the body, the tail loses its hold, the shape alters, and the animal dies. Its figure is now so small and distorted, that it cannot be recognised for the same being. It grows dry and hard, and on being touched with the point of a needle flies into a thousand pieces. Yet, notwithstanding so great an alteration has taken place, the animal may still be revived, though kept in this condition days, months, and even years, without interruption. All that is required for its resurrection is its being moistened with water. The period of humectation necessary to the recovery of the full and active principle of life is various, according to the species of the animal, and perhaps the circumstances in which it is found. Some revive in a few minutes, others require half-an-hour or more. Leeuwenhoek relates, that when he affused water on a quantity of sand that had been dry thirteen days, one animalcule attempted to swim in five minutes, but others not till after the lapse of three hours. It has been said, that those dry for years revive as soon as those that have been dry only a few hours. The precursors of animation consist in the hard and disfigured substance beginning to swell; a point appears at one extremity, which moves,

with alternate extension and contraction; the opposite part also becomes pointed: these are the head and tail. The rest of the organs successively unfold; the wheels are displayed; the animal resumes its original shape, and swims vivaciously through the fluid. The length of time during which Wheel-animals may be preserved in their quiescent state, and still retain the faculty of resurrection, has not hitherto been ascertained. Leeuwenhoek kept them dry twenty-one months, yet they recovered on new humectation. Baker revived them after a longer period. Fontana preserved them two years; and Spallanzani seems to infer, that he kept a quantity of sand containing these animals four years in a phial, and whenever a portion of it was moistened they revived.

There is another animalcule, which is known to enjoy the privilege of resurrection in a degree no less eminent than that of the rest; and, considering the place where it is most abundantly found, its nature may perhaps be considered even more extraordinary than theirs. The external appearance of a grain of blighted corn resembles soot, and its internal substance consists of a dry whitish matter, which examination with the microscope exhibits as an aggregate of linear corpuscula intricately interwoven together. Mr. Needham, in the course of a microscopical observation, having moistened this substance for the purpose of unravelling it, was agreeably surprised to see it immediately testify signs of animation, and the dry shrivelled corpuscula afterwards expand into so many lively active eels. Many naturalists have repeated his experiments, and established a number of interesting facts. If the fluid containing the eels evaporates, they gradually become lifeless; when totally gone, their motion has ceased. Unlike the other resurgent animals, they have not the prudence to forsake places where the water dries; but continue attached to the same spot without attempting to escape. On the fluid being restored, reanimation ensues, first beginning with gentle oscillations, then with writhing and contortion, and, lastly, with the full attainment of lively action. But it is to be remarked that these animals have no progressive motion; they neither rise in the water, nor crawl along the sides of the vessel containing them: hence they are always found at the bottom, appearing like a pellicle, lighter or darker, according to their numbers. The time of immersion required for their revival is various: some recover in three hours, or less. Baker quotes an instance where it was not less than forty hours; and, in certain cases, whole days are necessary. Resurrection is accelerated by heat, and retarded by cold. Speaking of these animals, Spallanzani observes, that the oftener humectation is repeated there will be the fewer resurgents. "I had a number of lively eels in a watch-glass, the first time they were revived. One thousandth part did not recover the eleventh time; and the seventeenth there was not one."

The heat of 144° and 149° destroys them almost immediately, though they can support 140° for several hours. If the grains which they inhabit have been wet, and exposed to heat, few eels will revive after 138° . A vacuum does not prevent their resurrection. There are undoubtedly limits, when, by the lapse of time, the resurgent faculty will be lost; but these are yet undefined. Mr. Needham carried blighted wheat from England to Portugal, the eels of which revived after two years desiccation. Baker recovered them after four years: and they are said to have revived after the extraordinary interval of twenty-seven years.

Leeuwenhoek and Hartsoeker both claim the discovery of seminal vermiculi; Haller ascribes it to Ludovic Hamma, a young German. On presenting the fluid taken warm from an animal, to a powerful magnifier, infinite numbers of vermiculi are observed swimming with very lively motion, and varying their course as fishes do in water. Their general figure resembles that of a tadpole, excepting that the tail is longer in proportion, and the body of smaller dimensions. If the portion taken for examination is of too thick consistency, it may be diluted with saliva, which is the only transparent liquid not fatal to the vermiculi; they then become clearly and distinctly visible, smaller than the red globules of blood. The human fluid being taken from a dead body, and presented to the microscope, the thermometer standing at 48° , nothing could at first be discovered, on account of its opacity. When beginning to dissolve, the irregular parts seemed in an indistinct slow fermentation; but, on increasing the magnifying power, the motion was seen to arise from corpuscula infinitely more minute than these parts, of a globular figure, and provided with a short filament, or tail: see *Figs.* 11 and 12. These were the vermiculi, which exhibited two kinds of motion, one consisting merely in oscillation from right to left, and the other in progression forward. But they seemed insensible of the surrounding objects, and blindly rushed against them; or, if involved amidst a number of obstacles, they pushed their way through the places where they found no resistance. In twenty-three minutes, their motion, which had been incessant, began to decline, and in an hour and a half it was almost totally gone.

The fluid of a ram being put into a watch-glass, it appeared to the naked eye in continual agitation, though situated on an immoveable plane. On examination with the microscope, this was observed to proceed from innumerable vermiculi all in motion, which were larger than the former; the body, an oval part, sometimes was immersed in the fluid, or disappeared, and sometimes came to the surface. Though the thermometer was at 77° , they hardly lived an hour.

Similar vermiculi are found in the prolific fluid of all male animals, from those of the largest size down to the smallest insect: and naturalists af-

firm, that a general resemblance pervades the whole, as the chief difference, except in a few examples, consists in the length and slenderness of the tail. But the size of the vermiculi does not depend on that of the animal, for they are found larger in the small ones, than in some of greater bulk: neither are they all of equal size among themselves, which is particularly evident in the fluid of the horse.

It is said, that these animals are never found in males until the age of puberty; that they decrease as life advances, and in old men are altogether wanting. The like is reported of the inferior animals; none could be discovered in very young rams; they were more numerous in young bulls, two or three years old, than those of five or six. They have been unsuccessfully sought for in the mule. In the human species, it is also said, that they do not appear during the prevalence of the venereal disease. All these facts perhaps require corroboration, by a series of more careful experiments than, we apprehend, they have yet received.

The use of the vermiculi is yet unknown. No sooner were they discovered, than various conjectures were formed concerning them, and these stood on plausible grounds, until overturned by more logical reasoning. The most important hypothesis was that which supposed them the germs of future animals; that they were transmitted to the female, and expanded into her offspring. But such theories have vanished.

Animalcules are found in the recently voided excrements of some animals, and also in the stomachs and during the digestion of the ruminating animals. The number of these animalcules is so considerable, that in five centigrammes of alimentary matter taken from the first and second stomachs of the sheep, for example, MM. Gruby and Delafond found from 15 to 20 animalcules of different species and various sizes. In the third, and especially in the fourth stomach, these animals are dead, and only to be recognised by the form of their carapace or transparent envelop, which then appears quite empty; while of those animals which possess no carapaces, no trace of them can be detected in their stomachs. In the small and in the large intestines, we find only some fragments of carapaces. Animalcules are also found, in great number, in the cæcum and dilated colon of the horse; while their empty carapaces occur in the contracted colon and rectum. The conclusion from these facts appears to be, that the organic matter of these animals, consisting of fibrin and albumen, supplies animal matter for digestion even to herbivorous animals; that in the sheep and horse, which take only vegetable matters into their stomachs, nearly a fifth part of these matters is destined to give sustenance to a great number of animals of inferior development, which, digested in their turn, will contribute some animal matter to the general nutrition of these herbivorous animals.

It has been supposed that certain diseases originate from animalcules. Nay, some authors have gone so far as to advance, that every different disease has animalcules peculiar to itself, and that they are actually exhibited by several in different stages. It is extremely probable, that they harbour in diseased organs, whose particular state may promote their origin: and we doubt not that numbers may at all times be found in neglected ulcers, or in cutaneous disorders; but perhaps they are chiefly of species analogous to the Infusoria. Those which Leeuwenhoek found inhabiting the teeth of various people were possibly of this description: they resisted the application of salt, but were destroyed by vinegar. Dr. Simon of Berlin discovered an animalcule which inhabits the hair follicles of the human skin; and Mr. Erasmus Wilson has shown that these animals exist in the sebaceous follicles of almost every individual, but are found more especially in those persons who possess a torpid skin, and that they increase in number during sickness. In living and healthy persons from one to three or four of these entozoa are contained in each follicle.

ANIMALIZATION. The transformation of the nutritive parts of food into the living substance of the body of an animal.

ANIMALIZED CARBON. A manufactured manure, invented and patented in France, used to a considerable extent on the continent, and introduced to Scotland in 1834. Mr. Owen of Copenhagen, who learned from its patentee how to manufacture it, and who established a manufactory of it in Denmark, says, "The chief excellency of this manure is, that it is powerful in its effects, occupies but little room, is easily separated, and conveniently used either by hand or drill; its effects are farther to insure a rich crop, by gradually ameliorating the soil, and rendering fallowing unnecessary. For wheat, rye, buckwheat, barley, and similar descriptions of corn, about 8 cwts. 1 qr. 16 lbs. is used per acre: it may be either broad cast or drilled in before harrowing. For flax, hemp, beet, potatoes, &c., about 1½ cwt. per acre; and 12 cwts. 2 qrs. 10 lbs. per acre for artificial meadows, different sorts of cabbage, rape, culinary plants, and for refreshing natural meadow land. For plants that are set in rows, a handful is put to each plant; for those which are transplanted, a child follows the planter, and throws a very small handful of the manure into each hole, which is immediately covered over with earth; in several places for rape, it is scattered out in rows along the roots of the plant, which the plough covers by forming a new furrow. On meadow land, it must be spread out in December or January, when the snow is not on the ground. What characterizes this manure most is, that it develops its effects so slowly and gradually, that it may be applied without danger in contact with the seed or roots of plants; in this it differs from a number of

other manures, which are less rich but more heating." Three varieties of animalized black appear in a long and valuable list of manures analyzed and mutually compared by Messrs. Payen and Boussingault,—one prepared for eleven months, another from the neighbourhood of Paris and recently made, and another made at Lyons and called Dutch manure; and the first of these contained 1.96 per cent. of azote, the second 2.96 per cent., and the third 2.48 per cent.; while coal soot, which figures in the same list, was found to contain 1.59 per cent., wood soot 1.31 per cent., animal black of the sugar refiners 2.04 per cent., English black 8.02 per cent., and average farm-yard manure 1.95 per cent.—*Quarterly Journal of Agriculture.—Boussingault's Rural Economy.*

ANISE,—botanically *Pimpinella Anisum*. An annual plant, of the burnet-saxifrage genus, and umbelliferous family. It is a native of Egypt, and was introduced to Great Britain in 1551. It grows to the height of one foot, carries a white flower, and blooms from June till August. Its seeds are annually imported in considerable quantities from Malta and Spain; and they have aromatic and carminative properties, and are used in medicine. The plant is sometimes grown in English gardens, in order that its leaves may be used for garnish or for seasoning; and it was, at one time, attempted to be cultivated in English fields as an agricultural plant, in order that its produce might be available for the distiller; but it was found to be injured by the slightest frosts, and to require a more genial climate or a much warmer exposure than almost any English farm can boast. The distilled plant, when used in blossom, yields a sweeter and more grateful tincture than can be obtained from the seeds. A good carminative for cattle, is either the seeds in a state of fine powder, or a mixture of the essential oil with any diluent; yet this carminative is far inferior to ginger or caraway. The oil is obtained by distillation from the seeds; and though habitually mixed with a great many cattle medicines, and regarded by the farriers of former generations as one of the most potent of drugs, it performs scarcely any other office than the communicating of an agreeable fragrance.—*Encyc. of Plants.—Bath Papers.—British Husbandry.—Clater's Cattle Doctor.—Youatt on the Horse.—Edin. Pharmac.*

ANISEED-TREE,—botanically *Illicium*. A small genus of exotic evergreen shrubs, of the magnolia tribe. Two species, the red-flowered and the yellow-flowered, are cultivated in Great Britain, but require to be treated as frame-plants. The red-flowered grows to the height of eight feet, and the yellow-flowered to the height of six; and both bloom in the early part of summer. The leaves of the aniseed-tree are very fragrant; and its capsules, when rubbed, have a strong smell of anise. The Chinese cultivate it for the seasoning of dishes; and the Japanese employ

bundles and garlands of it in the ceremonies of their heathenish superstition. The plant is easily propagated in Britain by layers, and can be propagated also by cuttings. Its appearance, when out of flower as well as when in bloom, is decidedly ornamental.

ANJOU CABBAGE. See CABBAGE.

ANKER. A measure of liquids, particularly spirits, in use in various European countries. The English anker contains 10 wine-gallons, or $8\frac{1}{2}$ imperial gallons, or 2310.62 cubic inches. The Scottish anker of 20 pints is equal to about $7\frac{1}{2}$ imperial gallons. In Amsterdam the anker is the fourth part of the AAM: see that article. In Russia it is the sixth part of an oxhoft, which is equal to 54.428 English wine-gallons. The Stettin anker contains 13.7 English wine-gallons, or 11.417 imperial gallons.—*Macgregor's Commercial Tariffs*.—*Kelly's Cambist*.

ANNONA. A genus of tropical fruit and ornamental trees and shrubs, forming the type of a natural order, and nearly allied to the Magnolia family. Seven species have been introduced to Great Britain; and about twenty-nine other species are known to botanists. Four of the introduced species—the sour-sop, the sweet-sop, the netted, and the smooth-fruited—are evergreen trees, growing to the height of from 10 to 20 feet; two—the marsh and the cork-wood—are evergreen shrubs, growing to the height of from 4 to 6 feet; and one, the cherimoyer, is a deciduous tree, growing to the height of 18 feet. All these seven species are natives of the tropical portion of America and the West Indies. The fruits of most of the genus are soft, pulpy, sub-acid berries; and in some instances are as large as oranges. The fruit of the sour-sop species abounds throughout Jamaica, is large, succulent, and similar in flavour to black currants, and, though much relished by Europeans, is so common in the island and so generally used by the poor negroes, as to be fashionably depreciated by the wealthy. The fruit of the cherimoyer species is oblong, scaly on the outside, and of a dark purple colour when ripe; it is soft, sweet, and most delicious; and it is esteemed by the Peruvians as one of the best fruits of their country, and has even obtained the reputation of being the finest fruit in the world, excepting the mangosteen. The fruit of the cork-wood species is sweet and fragrant, but narcotic, and therefore not eaten; and the bark of its tree serves the inhabitants of Jamaica for corks, and is popularly called the Jamaica cork-wood. One of the introduced species grows in the open air in England as an ornamental plant, but does not in that situation mature its fruit; and the other species require to be cultivated in the stove, and may there be easily fruited.—The order Annonaceæ comprises the genera *annona*, *uraria*, *unona*, *monodora*, *eupomatia*, *artabotrys*, *gualteria*, *asimina*, and *xylopia*; it consists wholly of trees and shrubs; it is, with a few exceptions,

found wild only within the tropics; and it is so closely allied to the order Magnoliaceæ as to be distinguishable from it only by minute botanical features.

ANNOTTA, or ANNATTO, —botanically *Bixa Orellana*. An evergreen tree of the West Indies, forming the type of the small natural order of plants called Bixiniæ, and remarkable for furnishing the well-known colouring annotta of commerce and of the dairy. Most of the plants of the order bixiniæ are tropical; and all are trees or shrubs; but they are few in number, and of little interest. The only genera known in Britain are *bixa* and *prockia*; and the only species of *bixa* known is *orellana*, the annotta. This plant grows twenty feet high, carries pink flowers, blooms from May till August, and can be successfully cultivated in Britain only in the stove. The bark is used by the inhabitants of Jamaica as material for ropes, and pieces of the wood as means of procuring fire by friction. The annotta of commerce is a precipitate from maceration of the red pulp which covers the seeds of the plant. One variety of it is manufactured in Cayenne into flags or cakes, each 2 lbs. or 3 lbs. in weight, of a bright yellow colour, softish to the touch, of considerable solidity, and usually wrapped in banana leaves; and another variety—that commonly employed in English dairies—is manufactured in Brazil into small rolls, each two or three ounces in weight, hard, dry, and compact, brownish without and red within. This substance has the reputation of being cooling and cordial; it is much used by the Spaniards to colour and flavour their chocolate and soups; and it has been recommended as of some service in bloody fluxes and disease of the kidneys. It is mixed with lemon-juice and a gum to form the crimson paint with which the Indians decorate their persons. It was formerly much used by dyers to form the colour called aurora; but was found to be comparatively evanescent, and it has in a great measure been abandoned. It continues to be employed, to some extent, as a pigment by painters. But its grand interest to the farmer consists in its very extensive use as a colouring matter for butter, and especially for cheese. A few of the paler-coloured yellow or orange cheeses are coloured with marigold flowers, saffron, and carrots; but most of even the paler-coloured, and all the high-coloured, derive the whole of their peculiar complexion from annotta. The cheese-makers of Gloucestershire give one ounce of annotta to one cwt. of cheese; and those of Cheshire give eight dwts. to 60 lbs. But as these quantities are far too small to medicate the cheese, or even to affect its flavour, the only advantage derived from the annotta is mere colour; and surely the appearance of Stilton or Dunlop cheese upon the table is to the full as agreeable as that of Gloucestershire or Cheshire cheese. The use of annotta, therefore, is sheerly whimsical, imposing per-

fectly useless trouble on the manufacturer, and some small ridiculous expense upon the purchaser. The mode of using it is to dissolve it in the hot milk immediately before the earning.

ANNUAL MEADOW-GRASS. See POA.

ANNUAL PLANTS. Plants which germinate, fructify, and die within a single year. They have but one stage in the process of their development, or pass, by only one series of functional acts, through all the gradations of their existence. They thus present a close analogy to the various kinds of animals which spring from eggs, arrive at maturity, propagate their species, and die, in the course of a single summer, or, in some instances, in the course of a single day. Some annual plants, in the climate of Great Britain, perform the cycle of their existence in the course of three months, and others perform it with difficulty, or with occasional failures in the maturing of seed, within the longest possible range from the breaking up of one winter to the commencement of the next; some can be treated as early biennials, sown late in autumn and flowering early in spring, and others as late biennials, sown in the middle of summer and flowering in the middle of spring; some are perfectly hardy, others are in the highest degree tender, and many have intermediate habits at all stages between hardiness and tenderness. A few plants, such as those of the genera *Tropæolum* and *Beta*, are annuals in a cold climate like that of Sweden or Scotland, and perennials in a warm climate like that of the West Indies. See article AGE OF PLANTS. Some annuals, as barley, oats, spring wheat, pease, and beans, absorb a main portion of the care of the British farmer; and others, such as stocks, amaranths, French marigolds, balsams, and some kinds of mesembryanthemums, make large demands on the care of the British florist. Annual plants collect and form their nourishment in the same manner as perennials; and they store it in their seeds in the concentrated substances of vegetable albumen, starch and gum.

ANNULOSA. A name given by many naturalists to that immensely numerous class of animals whose bodies and limbs are divided into ring-like joints, and which are called by M. Cuvier *Articulata*. See article ANIMALS. The term is derived from the Latin *annulus*, a ring.

ANOBIUM. A genus of wood-eating insects, of the Ptinidæ family. They bore most of the small circular holes, which so often abound in old furniture, and which always lessen its value and hasten its destruction. The species *Anobium striatum* is exceedingly abundant in Scotland; and, in many places, is the only species of insect by which dwelling-house timber is attacked. Its colour is dull brown, inclining to black; its thorax is hood-shaped; its head is partially hid beneath the thorax; and its elytra are longish and convex, and have their apex obtusely rounded. The perforations which it makes in timber indicate its size; and these are usually

about three-fourths of a line in diameter,—sometimes larger, and not unfrequently smaller. The larvæ of the insect are the principal borers of the perforations, yet they lie ensconced far in the interior, and are very seldom seen; and only when they have passed through the pupa state into the condition of perfect insects do they prolong the perforations to the surface of the wood, and escape to the open air. The larvæ appear small, white, soft worms, with six short minute feet. The head is harder than the body, and terminates in two jaws resembling pincers; and with these jaws, the insects gnaw the wood into the finest saw-dust. *Anobium striatum* and *Anobium tessellatum*, with perhaps two species of atropos, make the peculiar sound which is popularly called the death-watch, and which has struck alarm and terror into the heart of so many thousands of ignorant and superstitious human beings. The sound is made by the insects beating their head with considerable force against the plane of their position; it resembles a slight, sharp tapping on a table with the finger nail; and, when the insects are numerous in a house and the weather somewhat warm, it may sometimes be heard during the whole day. Timber which has been kyanized or which retains a tolerable proportion of its natural juices is not attacked by these insects; but unkyanized, unpainted, and very thoroughly dried timber is peculiarly liable to their attacks, and may speedily be reduced by them to an utterly worthless condition. Akin to the depredations of the anobium, though totally different in cause, is the ruinous condition of timber called DRY-ROT: which see.

ANODYNE. A medicine which relieves pain and induces sleep. Opium is the only anodyne used in farriery; but, when administered in doses of one drachm or upwards, it operates also as an astringent.

ANT. A well known tribe of insects, of the hymenopterous order. Some species which occur in the west of Africa and other foreign countries inflict ravages and perform feats of a stupendous and almost incredible character; and even some of our indigenous species, though guiltless of any extensive depredations, are sufficiently mischievous and abundant to be objects of painful interest to all cultivators of the soil. All the species are gregarious; they live in segregations of nests which have not inaptly been termed cities; and in many instances—some of which are not a little remarkable—they conduct united or combined operations for the common good of their communities. The members of each community comprise males, females, and workers, besides eggs, larvæ, and pupæ. The males and females, on emerging from the pupa state, have each four delicate transparent wings; and they serve principally for propagating the species. The workers are neuters or imperfect females, and never have any wings; and they feed the larvæ, protect the females, bring in provisions, make roads, con-

struct bridges, and, in general, conduct the various operations of building, foraging, devastating, defending, and fighting.

The ants of the warmer countries of the world, particularly those of Africa, South America, and the West Indies, construct large, intricate, and wonderful dwellings, which have astonished travellers, and challenged the admiration of the most phlegmatic naturalists; but the ants of Britain, though very various in habits, construct abodes which are more remarkable for their annoyance to man or their mischievousness to the soil than for either size or intricacy. The turf ant, *Formica cæpitem*, a small dusty brown insect, frequent in commons and pasture-fields, usually selects a tuft of herbage, piles up small gravins of earth into the partitions of cells and chambers, and makes the stems of the herbage serve as props and the grassy leaves as covering. The yellow ant, *Formica flava*, gnaws portions of wood into saw-dust, mixes this with earth and spiders' webs, and employs the mixture in constructing the chambers, stages, and galleries of its mimic city. The fallow ant, *Formica rufa*—the largest of the British species, and not uncommon in woods and pleasure-grounds—constructs very numerous galleries and chambers in a series of successive stories, from an excavated base to some height above the surface of the ground, and gives the whole such an exterior finish as to make it resemble a considerable mound or little hillock of sand and earth, with bits of wood, leaves, twigs, and grains of corn in apparently indiscriminate mixture. The red ant, *Myrmica rubra*, common in gardens, and not unfrequent in pasture-fields, makes burrows and chambers under stones or in the ground. The brown ant, *Formica fusca*, ingeniously and industriously constructs habitations with a series of stories in clay. The jet ant, *Formica fuliginosa*, excavates horizontal galleries in a series of stories in the trunks of old oaks or willows; and these galleries are all eventually stained black, and sometimes have the appearance, though on a mimic scale, of elaborate carved work.

The males and females of an ants' nest usually emerge from their pupa state in August or September; and they may then be seen commencing a new course of existence, issuing from their nest, rising into the air, and settling on posts, gates, and stones, and sometimes forming little clouds, which whirl and twist through the air, and seem to comprise thousands or even myriads of beings. The males have neither stings for defence nor sufficiently strong jaws for labour and the collection of food; and they speedily perform their peculiar function and perish. A vast proportion of the females, in common with all the males, are either devoured by birds or driven into rivers, lakes, and ponds; and some of the remaining portion of the females re-establish the old nests, some found numerous new colonies, and all speedily lose their wings, and commence laying

eggs.—Ants are torpid during winter, and do not need, like bees, to lay up stores of provision. They are singularly fond of the sweet juice, popularly called *honey-dew*, exuded by aphides; and colonies of them, particularly of the yellow ant, often appropriate particular trees or branches of trees for the sake of their honey-dew, or actually enclose groups of aphides and keep them as peculiar property, angrily and steadily resisting the encroachments of all other ants upon their premises.—Some species of ants, particularly the fallow ant of Britain and the remarkably working ants of tropical countries, frequently perform emigrations. Rival colonies of the fallow ant sometimes engage in battle, thousands on each side; and they occasionally fight with such engrossing pugnacity and such pertinacious obstinacy as to be incognizant or careless of human observation. The workers or neuters of the rufescent and sanguineous ants, *Formica rufescens* and *Formica sanguinea*, common on the continent, though very rarely if ever found in Great Britain, compel the workers of the species *formica fusca* and *formica cunicularia*, to serve as their auxiliaries or slaves. Various other interesting facts might be pointed out in the industrial national history of European ants; and an absolute volume of interesting facts, many of them utterly astonishing, might be collected respecting the industry, economy, achievements, and policy of the ants of the tropics. "The ants are a people not strong, yet they prepare their meat in the summer." "Go to the ant, thou sluggard; consider her ways, and be wise."

One of the most disastrous and wonderful depredations by ants on record, occurred in 1780, in the island of Granada, and was effected by the sugar-eating ant, *Formica saccharivora*. Literal torrents of the insect descended from the hills, filled the roads and the plantations for miles, destroyed whole estates of sugar-canes by eating the plants through the roots, killed rats, mice, reptiles, birds, and domestic quadrupeds, and, in some instances, dammed up rivulets, and formed with their accumulated carcasses mounds or bridges for surviving myriads to pass the streams with safety. Large fires were lighted in their path to arrest them, but were extinguished by their progress; a reward of £20,000 was offered to any person who should discover an effectual mode of destroying them; and had they not been providentially swept away in the torrents of a terrific hurricane, they probably would have converted the island into a wilderness. Though British ants have never even remotely imitated such awful devastation, yet they every year give considerable annoyance to a large proportion of both farmers and gardeners, and they everywhere require to be kept in check, or hindered from too prolific a propagation. The more common kinds, *Formica fusca* and *Formica rufa*, frequently establish their colonies at the root of fruit-trees, ascend the stems at their convenience, and prey largely upon

the fruits; they often associate themselves with wasps, wood-lice, and earwigs, and share in their depredations; and, in many districts of country, they destroy considerable quantities of linseed, hempseed, and rapeseed, and take very extensive and most mischievous possession of grass fields and other dry pasture-lands. Their nests or hillocks in the fields look to the eye like mimic mounds or small hay-cocks; they utterly impoverish or rather temporarily destroy every inch of land which they occupy; and they very often have possession of one-twelfth or one-tenth of a field,—and, in the case of old and neglected dry pastures, they sometimes succeed in usurping one-third, one-half, or even more than one-half. A species of one of the smallest kind of ants, *Myrmica unifasciata*, found its way some years ago into the very heart of London and some other large towns, passed in swarms and mimic torrents into the interior of houses, and, in some instances, made such dismal havoc and took such large possession as to compel the inhabitants to flee, and occasion the houses to be condemned.

A thin arsenic syrup, made by boiling together one ounce of arsenic, some sugar, and a quart of water, may be placed in oyster-shells or other small vessels at the foot of fruit trees infested with ants; and it will speedily attract them by its sweetness, and almost instantly prove fatal; yet it is so very active a poison that it ought never to be used when children or any valuable domestic animals can have access to the locality. Gardeners ought rather to find out and disturb the ants' nests a little before the time of the males and females emerging from their pupa state, and so terminate their depredations by preventing their propagation.—Ant-hills on grass lands ought all to be destroyed in the same season in which they appear. Some farmers, either in summer or autumn, dig up the ant-hills, cut them in pieces, and scatter them in the vicinity; but the ants, instead of being destroyed by this treatment, conceal themselves for a little among the roots of the grass, and then form new communities and ant-hills, and in consequence are mischievously disseminated. When the ant-hills are interfered with in summer or autumn, they ought to be lifted by the spade into heaps, and burned; but they are far more effectively and at the same time, easily destroyed in winter, simply by being turned upside down and placed a little aside by the spade; in order that the ants may be killed by the frost. "The most usual mode is to cut off the crown of the ant-hill with a sharp spade of a semicircular form—somewhat in the shape of a week's old moon, with the horns at about ten inches distance—and laying it with the grassy side downwards upon the ground. The ants are thus cleared out, the clods being completely pulverized and thrown around; and the hole is left empty for three or four weeks to secure the destruction, by the frost and rain, of any insects which may still remain; after which the sod is

replaced in its former position, and trodden or rolled down until even with the surface. The operation is commonly done at any leisure time during the winter; but some farmers either burn the clods, or else put quick lime in the holes before digging them up, in which case they deem it preferable to defer the process until the early part of the spring, as a top dressing is thus formed for the growth of the seeds." An expeditious method long ago practised in Norfolk is, with any one of several ploughs invented for the purpose, to cut off the ant-hills level with the field, and afterwards to cart them away; but this method seems merely to diminish or greatly check the ants, and not to exterminate them. Little cumuli or heaps of sandy particles, called sprout hills, are sometimes formed in meadow or hay fields by ants in wet weather, and they very quickly blunt the edge of the scythe, and serve as niduses for new communities; but they may readily be destroyed by heavy rolling, or even by the studied tread of the feet of the hay-makers.—No better a method of assailing the home kind of ants can be practised than to scald them with boiling water. "I was astonished one morning in going into my dairy," says a correspondent in the 'Magazine of Domestic Economy,' "to see the walls and floor for the space of a yard literally covered with these insects, and for a time considered their expulsion to be hopeless; however, I searched carefully to discover if there were any opening where they could obtain egress; and at length found the mass of life was most dense and full of motion at one spot. It was a very small hole at the junction of the wall and floor. I immediately had a tea-kettle of boiling water brought, and deliberately poured half of it into the hole, and the remainder over the ants that were around. Their death was instantaneous; and the dairy being on the ground floor, no ill consequences could arise from the damp occasioned by the water."—*Pictorial Museum of Animated Nature*.—*Mr. Duncan on Insects in Quar.* *Journal of Agr.*—*Smellie's Philosophy of Natural History*.—*Treatise on British Husbandry in Lib. of U. Knowledge*.—*Sproule's Treatise on Agr.*—*Society of Gentlemen's Complete Farmer*.—*Magazine of Domestic Economy*.—*A. Young's Farmer's Calendar*.

ANTENNÆ. The articulated flexible horns, on the head of insects and crustaceous animals; commonly two in number, and very rarely four. These are such a peculiar and prominent feature, that most of the older entomologists have founded one of the leading characters of the different genera of insects on their situation, structure, and appearance. All insects, however, are not provided with antennæ: in the spider, scorpion, and some monoculi, they are entirely wanting. It is to be observed, in general, that perfect insects, with six legs, have two antennæ; but that those having more, either want antennæ, or have more than two, such as crabs and lobsters, if

these animals are still to be considered as belonging to the insect tribe: whence, the later entomologists have rather been disposed to reject the antennæ as a constant and invariable characteristic. The horns of snails, and other animals of the genus *Mollusca*, do not strictly come under the description of antennæ, from being retractile, and wanting articulations. Most larvæ want antennæ; and although present in several, they are of a very different quality from what they appear in the perfect insect; from this, however, there are some exceptions, in which they are the same in both.

In the mature insect, the antennæ are extremely diversified in size, shape, and organization. In the *Notonecta*, or boat-fly, they can with difficulty be discovered; and in the *Nepa*, or water-scorpion, they are so minute that intelligent naturalists have been induced to deny their existence. Some consist of only two or three articulations, such as those of the common fly; others of between two and three hundred, such as those of the lobster. From this diversity in appearance they are denominated cetaceous, serrated, clavate, filiform, pectinated, and the like. In a few instances they are short, and terminated by a single hair, as in the gadfly; others are beautifully pectinated, as in various phalence; or resemble tufts of feathers, as in mosquitoes and tipulæ. Such antennæ form the most elegant microscopical objects. Not only is there a great difference among the antennæ of insects in general, but also in those of the same genus, and even of the same species. The queen-bee and workers have fourteen articulations, while the males have only thirteen. The structure of those of the male is likewise sometimes found different; the male mosquito has feathered antennæ, those of the female are filiform and plain. We should also observe, that the antennæ of quite different kinds of insects are known to resemble each other.

The substance of the antennæ is not muscular: they are composed of a series of minute cylinders jointing into each other, and enclosing an apparatus of nerves, muscles, air-pipes, and cells.

Nothing has been the source of greater speculation than the use of the antennæ; nor is this surprising, considering the variety constantly exhibited in their structure, occupation, and appearance. Some insects seem to keep them in continual employment; in others they are preserved in a quiescent state. Those of the *ichneumon* show an incessant tremulous, vibratory motion, anxiously searching into every crevice; while those of the carrion fly scarcely appear endowed with flexibility. They have successively been considered as the organs of hearing, feeling, smell, and taste; or of an unknown and indefinite sense.

Bonnet seems to think the antennæ the organ of smell. Different insects, he observes, have an exquisite sense of smelling; the organ of which is yet undiscovered. May it not reside in the antennæ? Insects are unquestionably affected

by the emanation of odours; the wasp is attracted by honey, the bee by flowers, and the fly by carrion. Nay, a plant which exhales the smell of carrion, deceives the fly, which alights on it to deposit its eggs. Yet we should reflect that the means of perception are not indispensably the same in animals provided with antennæ as in those of larger size, or those without them, provided with an organ exclusively adapted to receive such impressions. Lehmann, from the result of experiments on this subject, denies that the antennæ are the olfactory organ. He judges that the olfactory organ must be sought in the spiracula: "for what else," says he, "is the sense of the particles inspired than smelling?" Lehmann also denies that the antennæ are at all connected with the sense of taste. But it is evident, he thinks, that they are adapted for feeling in an eminent degree. On attending to the motions of the curculio, an animal which advances with slow and cautious steps, the antennæ are always seen extended before it, as if feeling the way. When the *cerambya* is at rest, no use is made of them; when it begins to move they are stretched out, and employed in examining what is fit for each progressive step. The aphides rarely move; but no step is ever made until the ground is ascertained by the antennæ. Those of the *ichneumon* flies are in unremitting action, exploring all the surrounding objects, and leaving nothing untouched. Marsham has observed the *Ichneumon investigator*, in searching out a proper place for depositing its eggs, approach a hole in a wooden post, and thrust in its long antennæ up to the head; then retire and try other holes and crevices, until a suitable one was found. If the *oniacus* is withdrawn from its dark retreats, it refuses to advance a single step, until the safety of its march has been ascertained by means of its antennæ. On touching the *Silpha germanica*, it immediately closes up, counterfeiting death; and all the limbs, along with the antennæ, are closely contracted. But when its apprehensions of danger diminish, the antennæ are cautiously unfolded; if nothing threatens, the whole members gradually expand, and the animal makes its escape; if still uncertain of security, the antennæ are replaced down the thorax. The utility of such a sense, residing to an exquisite degree in the antennæ, may readily be appreciated, on attending to the natural abode of numerous animals provided with them. Many dwell in dark, irregular chasms, clefts, or crevices, which requires an organ of extreme sensibility to explore their way.

Although feeling may thus be the principal office of the antennæ, those of some insects are so small, and placed in such a situation, that for this office only they can apparently be of very little use. Lehmann thence supposes, that they may be adapted for conveying impressions of the state of the air. The opinions of those, he observes, who maintain the possibility of other senses

existing, than what are already known to us, are not to be despised. And he shows that insects are, in various cases, sensible of the peculiar state of the atmosphere. The bee, for example, suddenly retreats to its dwelling on the approach of rain; ants, on a threatening storm, withdraw their young from the surface of the earth; during a humid sky, mosquitoes seek to harbour in our houses; and the nocturnal flight of beetles indicates the serenity of the weather. It is necessary that some organ should be susceptible of such impressions, when we reflect that a drop of rain will extinguish life, that unusual moisture will unfit the wings for use, and unusual heat endanger the fracture of the elytra; not forgetting either that only a slight degree of cold stiffens the limbs of insects, and reduces them to a state resembling death. But the whole surface of their bodies being covered with a strong and hard involucrum, renders it less sensible of the different transitions continually occurring in the atmosphere; while the softer substance, of which the antennæ are composed, is better adapted to warn them of those conditions on which their safety depends. Therefore they are surely the organ best calculated to receive the impressions of the air, if any one is susceptible of external effects. The feathers, branches, hairs, and spines, so numerous proceeding from the antennæ, may all be devised to expose a greater surface, or some portion more acute in receiving impressions. Even the antennæ of dead insects are injured by the humidity of the atmosphere. The melolontha, or cock-chaffer, gradually unfolds its lamellated antennæ, to try the state of the air, and never previously attempts to take flight. On removing a butterfly sitting in the sun, with its antennæ erect to the shade, it immediately begins stretching them out, as if to ascertain the change that has taken place. It is necessary that those of males and of neuters should be larger than those of females, because the former roving about more in quest of females, and the latter in executing their work, should sooner become aware of the approaching changes of the atmosphere. Lehmann concludes on the whole, that, as the antennæ are not the organs of either smell, hearing, or taste, their principal, though not sole office, is feeling. But they are also endowed with an unknown sense, which he denominates *aeroscepsin*; and conjectures that, in certain species, they may contribute to the defence of the head.

M. P. Huber looks on the antennæ of ants as the means of imparting their mutual wants and necessities; and he seems to admit the *aeroscepsin* of Lehmann, as also residing there. When two ants meet in their courses, they examine each other with the antennæ: those which go abroad return full of a liquid aliment, which they disgorge into the mouths of those remaining at home. But the hunger of the domestic ant is intimated to the erratic one, by repeated alternate blows with the antennæ; and intelligence

that the latter has food to bestow, is, on its return, reciprocally intimated by similar motions.

M. Straus-Dürckheim rejects the opinion that the antennæ are organs of touch, or 'feelers' as they are so commonly called; but conceives that they may serve for the perception of sounds. "The solidity of the envelop of antennæ renders these organs well adapted to undergo the same vibrations as the air, in the same manner as the strings of an Æolian harp vibrate and emit various sounds according as they are differently struck by the air. In this view, however, we might infer that nature would have made antennæ in the form of rods, consisting of a single piece, in order that they might be more susceptible of vibrations; but it ought to be considered, that these organs would, by such a conformation, have been much exposed to breaking, while, in consequence of their jointed form, they have the advantage of regulating the degree of vibration at pleasure, as may indeed be observed when insects listen with attention; I mean, that the joints of the antennæ perform the same functions as the chain of small bones in the chamber of the human ear, inasmuch as they form a similar chain, and transmit the vibrations of the air to the auditory pulp."—*Lehmann de Fabrica Antennarum*, 1799.—*Lehmann de Usu Antennarum*, 1800.—*Latreille sur les Fourmis*, 1802.—*P. Huber Relations des Fourmis avec les Pucerons, et les Galle Insectes*; *Francis Huber's New Observations on the Natural History of Bees*, 1808.—*Marshall on the Ichneumon Investigator in Transactions of the Linnean Society*, vol. iii.; *Kirby Monographia apum Angliæ*, 1802.—*Œuvres de Bonnet*, tom. vii. in 8vo.; *Baer's Opuscula Subseiva*, part ii.—*M. Straus-Dürckheim on the Anatomy of the Cock-chaffer, as quoted in the Penny Magazine*, article ANTENNÆ.

ANTENNARIA. A genus of herbaceous plants, of the composite order. They are closely allied to the genus *Gnaphalium* or everlasting, and indeed are botanically founded on the best known or most common species of everlasting, the *Gnaphalium margaritaceum* of Linnæus. Two species are indigenous in England; and six other species have been introduced from continental Europe, Africa, Nepal, and North America. One of the indigenous species, *Antennaria dioica*, grows about three inches high, and carries a pink flower from May till July; and the other, *Antennaria margaritacea*, grows 1½ foot high, and carries a yellow flower from July till September. Both of these species are perennial. The name *antennaria* alludes to the fancied resemblance of a part of the fructification to the antennæ of insects.

ANTHER. The minute bag or viscus, which contains the pollen or fine fecundating powder of a flower. In most plants, it is situated, in a terminal manner, at the top or upper end of a filament; but in some, it is differently situated. Its chief feature of interest to an unbotanical cultivator is connected with the pollen. See POLLEN.

ANTHEMIS. See CHAMOMILE.

ANTHERICUM. A large genus of herbaceous plants, of the Asphodel family. Most of the species are African; the total number is about fifty; and only one, *Anthericum serotinum*, is indigenous in England, growing upon the English mountains, and carrying a white flower in August and September.

ANT-HILL. See ANT.

ANTHONOMUS. A genus of insects of the weevil tribe. The species best known to farmers and gardeners is called *Anthonomus pomorum*, and has this name from its infesting apple-trees; and it has long been distinguished as a formidable pest of the cider counties and of almost all British orchards. It differs from most other kinds of weevil in the length and slenderness of its rostrum compared to the shortness and breadth of its body. Its rostrum is at least half the length of its body, and is proportionately slender; its antennæ are twelve-jointed, and inserted near the middle; its thorax is somewhat conical, and much narrowed in front; its elytra are broad, and widen behind; and its legs are long, and thighs very thick. Its entire length is about two lines; and its colour is a pitchy red, obscured by a sprinkling of short ash-gray hairs. This insect passes the winter beneath lichens and the bark of trees; and, so early as March, emerges from its winter quarters, warms itself in the earliest sunshine, and begins to rove about gardens and orchards. The female is ready to lay her eggs when the flower-buds of the apple-tree are either beginning to expand or have fully developed; and, with her long augur-like proboscis, she pierces a deep hole in the calyx, and deposits her eggs beyond the reach of small birds and of the weather. A small white grub, similar to the larva of any other long-snouted weevil, speedily evolves from the egg, eats up all the interior parts of the flower, utterly destroys its power of fructification, and occasions it soon to assume the shrivelled form and sickly brown colour which are popularly denominated the apple-blight. Attempts to avert the blight must be directed, not against the eggs or larvæ, for in that case they would be vain, but against the full-formed insect during the period of its being in winter quarters. Yet specific attempts of any sort against the anthonomus are not likely to be successful; and only those efforts ought to be relied upon which are found most efficacious against all the sorts of insects by which fruit trees are assailed—particularly the brushing, washing, and painting of garden-walls, and the application of finely pulverized caustic lime, or of some pungent compound preparation, to the bark or entire body of all trees in which the insects may be supposed to have lodgments.

ANTHOXANTHUM,—popularly *Spring Grass*. A small genus of grasses, of the Bromus tribe. One species is indigenous in Great Britain; two species have been introduced from respectively

Morocco and Spain; and three other species are known to botanists. The genus presents the curious botanical peculiarity of being in all natural respects a true grass, and yet belonging to a different artificial or Linnæan class from the other grasses. The Morocco or bitter species, *Anthoxanthum amarum*, is perennial, grows one foot high, and flowers in July. The Spanish or ovate species, *Anthoxanthum ovatum*, is an annual, and also grows one foot high, and flowers in July. The indigenous or sweet-scented species, *Anthoxanthum odoratum*, is a perennial, grows one foot high, and flowers about the middle or toward the end of April; and this native species is the only one which can be considered as agricultural, and challenges nearly all the attention due to the genus. See *Fig. 4. Plate VI.*

The indigenous anthoxanthum grows wild in most of our meadows and pastures; it imparts to all our meadow hay its peculiar sweet odour, resembling the fragrance of woodroff; and it diffuses this delightful odour, also, through the air of the uncut meadows from its ripening seeds. It is one of the very few plants which, both in their green and in their ripe state, contain benzoic acid; it derives its generic name of anthoxanthum, or yellow-flower, from the circumstance of the valves of its calyx being sprinkled over with minute yellow dots, similar to those of black currant berries; and it is supposed to yield its rich fragrance from the connexion of these dots with its benzoic acid. It constitutes part of the herbage of almost all varieties and situations of natural pasture; yet though habituated to every kind of soil, and though found in meadow and on mountain throughout England, Scotland, and Ireland, it attains perfection only on soils which are deep and moist. It challenges considerable attention for the earliness of its growth; and yet it yields a smaller proportional bulk of vernal herbage than some grasses which are late in flowering. It is, in all respects, a very hardy grass; and may be ranked as one of the most enduring or technically permanent. It continues to vegetate and throw up flowering stalks till the end of autumn; and appears to be considerably more valuable in the herbage of its after-grass than in that of its spring crop. It gives a grateful odour to both meadows and meadow-hay, and has been observed to abound in such pastures as produce richly flavoured mutton; and it has, in consequence, been recommended as a large ingredient in a mixture of artificial grasses or of sown pasture land, with the view of improving the flavour of mutton. Yet its seeds are gathered with considerable difficulty, and are comparatively high in price; its stalks are of little value, and seem to be much disliked by cattle; and even its leaves, though eaten in pastures along with other herbage, are by no means so much relished as those of the majority of pasture grasses. If sown with nothing but clover, sheep will probably not touch it; if sown with

clover and only another grass, such as a species of meadow foxtail, it will still be scarcely touched; and not till sown as but a minor ingredient in rather a numerous mixture will it be tolerably well relished, and fully accomplish its peculiar uses. This grass contains little saccharine matter, abounds in mucilage, and contains a larger proportion of bitter, insoluble, extractive matter than most other grasses. The green plant, in its early spring condition, has been ascertained to contain 80 per cent. of mucilage, 2 of saccharine matter, and 18 of bitter extractive; and the matured plant, at the time of its seed being ripe, has been ascertained to contain 86 per cent. of mucilage, 8 of saccharine matter, and 6 of bitter extractive and salt. When grown upon sandy loam, it has been found to yield per acre, in the 1st of April, 3,484 lbs. of green produce, and 95½ lbs. of nutritive matter; when in flower, 7,827½ lbs. of green produce, 2,103½ lbs. of dry produce, and 122½ lbs. of nutritive matter; when its seed is ripe, 6,125½ lbs. of green produce, 1,837½ lbs. of dry produce, and 311 lbs. of nutritive matter; and when in aftergrass, 6,806½ lbs. of green produce, and 239½ lbs. of nutritive matter. But though considerably inferior to some other grasses in nutritious value, and in spite of its not being very well relished by cattle, it ought always, in small quantity, to be an ingredient in the sown grasses of at once meadows, dry pastures, parks, and pleasure-grounds. An essential oil which can be obtained from this grass, has an agreeable odour, and may be used as a mild aromatic and stimulant.—*Withering's Botany*.—*Loudon's Enc. of Plants*.—*Low's Elements of Practical Agr.*—*Sproule's Treatise on Agr.*—*Liebig's Chemistry of Agr.*—*Sinclair's Hortus Gramineus Woburnensis*.—*Treatise on British Husbandry in Library of Useful Knowledge*.

ANTHRACITE. A coal formation, containing little or no bituminous matter, and sometimes as high as 95 per cent. carbon. The name, which is derived from the Greek, signifies merely carbon or coal. The largest formation is comprised in the several basins in central Pennsylvania, east of the Susquehanna river; other formations exist in England and France, besides smaller deposits of the same geological age; and a few localities where basalt intruded through the brown coal, appears to have deprived it of its bitumen, and converted it into a species of anthracite.

The volatile matter in the purer varieties is almost exclusively water; but in the same basin may be traced a gradual transition from those burning without flame to those containing a sufficient quantity of bitumen to burn more freely and with flame. The ashes of anthracite necessarily varies in composition, consisting of a silicate of alumina, with variable quantities of oxide of iron, magnesia, lime, &c., the two last being often absent. Sulphur (in sulphuret of iron, pyrites) is also a variable constituent, from ½ to 1 per cent., being usually much less than the

proportion in bituminous coals. An analysis of several specimens of anthracite is given by Professor Johnson in the *Journal of the Franklin Institute, Pennsylvania*, of which the following is a tabular view:—

Water,	3.43	3.26	0.00	2.19	0.40
Volat. Matter, ..	4.08	1.05	9.60	4.23	5.51
Fixed Carbon, ..	87.48	91.69	85.34	92.30	91.01
Ashes,	5.01	4.00	5.06	1.28	3.08
	100.00	100.00	100.00	100.00	100.00

Of twelve specimens analyzed by Berthier, the mean per-centage of ingredients was—

Volatile matter,	7.37
Fixed carbon,	79.15
Ashes,	13.25

A much more minute analysis of anthracite from Wales is given by Dr. Schafhaeutl, in a report submitted to the Anthracite Patent company. The following is the composition of two samples:—

Moisture,	00.00		0.300	
Carbon,	92.42		94.100	
Hydrogen,	3.37	} Volat. matter, ..	2.390	} Volat. matter, ..
Oxygen,	1.43		1.336	
Nitrogen,	1.05		5.97	
Sulphur,	0.12		0.874	
Ashes,	1.61		trace	4.6
	100.00		99.932	
			Loss, .068	
			100.000	

In these specimens, the quantity of volatile matter varies from 4.31 to 9.6. It may be stated to be on an average about 5 per cent. The greatest amount of carbon is 94.1.

Anthracite has been employed for heating apartments for culinary operations, both in close stoves and open grates. The advantages it possesses for these purposes are the long-continuance and uniform combustion of the fire, the little attention it requires, freedom from smoke, its greater cleanliness, and the little liability to communicate fire from sparks, &c. Its disadvantages are the intensity and very drying character of the heat, although the latter difficulty may be obviated by the use of open vessels of water, with stoves and hot-air furnaces. The same advantages render it very superior as a fuel for numerous technical processes. After many unsuccessful attempts made in Pennsylvania to employ it in the reduction of iron from its ores, Mr. Crane fully succeeded at his iron-works in Wales, England, in 1837, by the use of the hot-blast, since which it has been employed with variable success in the United States. For some technical operations it is less valuable, such as in the manufacture of glass, in some reverberatories, where the transported heat of flame appears to be better adapted to the purposes required. Notwithstanding the great number of practical applications which anthracite has received, we have yet to witness its far more varied and general employment both in domestic economy and in manufactures.

ANTHRISCUS. A small genus of herbaceous plants, of the umbelliferous group. The common species, *Anthriscus vulgaris*, sometimes popularly called rough chervil, is an annual weed of the hedge banks of Great Britain; and possesses a close resemblance to the common chervil, *Chærophyl-
lyllum sativum*, but is poisonous. Some of the Dutch soldiers who were in Britain in 1745, mistook it for common chervil, and were poisoned by it. A perennial species, *Anthriscus nodosa*, was introduced to Britain from Sicily in 1656; and seven other species are known to botanists.

ANTHYLLIS. See KIDNEY VETCH.

ANTICOR. A malignant swelling in the breast of horses, sometimes extending to the very sheath under the belly, and accompanied with fever, great depression and weakness, and a total want of appetite. Large and repeated bleedings are required, to abate the inflammation; emollient clysters, each containing an ounce of sal prunella, ought to be injected twice or thrice a-day; and unguents and opening poultices ought to be daily applied to the swelling. On the fourth or fifth day, when the inflammation in the throat is subdued, the swelling on the breast should be so treated as to be brought if possible to a state of suppuration; and when suppurated, it must be opened with a knife, and dressed with strong turpentine ointment. If the swelling will not suppurate, and if it so increases as to endanger suffocation, it must be pierced with a hot-pointed cautery, and afterwards dressed with very stimulating ointment, such as a turpentine ointment sharpened with a little cantharides and euphorbium, and the adjoining parts bathed and fomented with preparations of marshmallows. Two distinguished veterinary surgeons of the old school advised that, when the swelling will not suppurate, a piece of black hellebore steeped in vinegar should be introduced through an opening of the skin, and allowed to remain during twenty-four hours, to act as a stimulant, and occasion a counter-irritation.

ANTIDESMA. A genus of evergreen East Indian plants of the class Dicoecia and order Pentandria, but of very doubtful station in the natural botanical system. Two species, the laurel-leaved and the panicled, both growing to the height of ten feet, were introduced about fifty years ago to Great Britain; and eight other species are known to botanists. The bark of the laurel-leaved species is used in India as a material for ropes; and a decoction of the leaves is said to be an antidote against the venom of serpents.

ANTIDOTE. See POISON.

ANTIMONY. A white shining coloured metal. The ore of antimony, from which it is obtained by fusion, is an aggregation of extremely small sparkling granules, and, when first broken, has the appearance of a lump of the purest steel. Productive mines of the ore occur in Hungary, Transylvania, Bohemia, Saxony, and many parts of France. Antimony is used by founders, type-

founders, pewterers, clockwork-makers, and manufacturing chemists; and four preparations of it—the black sesqui-sulphuret of antimony, emetic tartar, the compound powder of antimony, and the chloride or butyr of antimony—are used as horse and cattle medicines.

The black sesqui-sulphuret of antimony has a shining, striated appearance; is hard, brittle, and very heavy; and consists of antimony and sulphur in the proportion of 20 weights of antimony to 7 weights of sulphur. A professed powder of it is sold in the shops, but ought never to be purchased by either farmer or farrier; for it is often grossly adulterated with lead, manganese, forge-dust, and arsenic. If a little of the adulterated powder be placed on a red-hot iron plate, the pure sesqui-sulphuret will wholly evaporate, the arsenic will also evaporate but will occasion an evident smell like that of garlic, and a portion of the lead and the manganese will be left upon the plate. The pure sesqui-sulphuret, bought in bulk and powdered by the retail purchaser, is a good alterative for horses and other animals, and, in mixture with sulphur and saltpetre, is given in doses of various strength and frequency, according to the nature of the disease and the degree of desired rapidity in the change proposed to be effected in the system. An ounce, however, is the most common quantity for a full-grown horse; and this is repeated according to circumstances. The sesqui-sulphuret of antimony is said to have also been advantageously administered in the fattening of hogs and cattle.

Emetic tartar, or tartrate of potash and antimony, is a compound of super-tartrate of potash and oxide of antimony; and it is, in a slight degree, decomposable by the action of light, and ought to be kept in a jar or green bottle. An adulteration of it is frequently made with arsenic; but this can easily be detected by its emitting a garlic smell when placed upon a red hot iron, or by a solution of it with sulphuret of ammonia not yielding a beautiful gold-coloured precipitate. Tartar emetic is a very useful nauseant, sedative, and sudorific; and exerts a considerable irritating power upon the skin. When administered in doses of from half a drachm to a drachm to horned cattle, or from a drachm to a drachm and a half to horses, but in combination with a due proportion of nitre and digitalis, it has great efficacy in lowering the circulation of the blood, and promoting restoration to health, in all cases of inflammation of the lungs, in all catarrhal affections, and especially in the particular forms of pleurisy with which domestic animals are so liable to be attacked; and when administered on an empty stomach, and for several successive days, in combination with some mechanical vermifuge such as tin filings or ground glass, in doses of two drachms to a horse, it acts very beneficially in cases of affliction with worms, and, even when it fails to expel them, will materially improve the horse's condition, and promote the sleekness of

his coat. When combined with lard into an ointment, in the proportion of one drachm or two drachms of itself to an ounce of the lard, it acts powerfully as an external application in affections of the chest; but it sometimes produces extensive sloughings, and, on that account, ought not to be used except when less active remedies are likely to fail.

The compound powder of antimony is the same or very nearly the same as the well-known James's Powder; and, either alone or in combination with mercurials, is an excellent sudorific and a good antifebrile medicine. The dose to a hog is six grains; and to a horse from one drachm to two drachms. It has been used alone, in the treatment of epidemic catarrh in the horse, by some distinguished practitioners; yet it evidently is much inferior in power to tartar emetic. Adulterations of it with chalk, burnt bones, and other white powders, are so very common that no dependence can be placed on the antimonial powder usually sold by druggists; yet these adulterations may easily be detected by means of muriatic or sulphuric acid.

Chloride of antimony, constituted by chemical combination of chlorine with antimony, and popularly called butyr of antimony, is one of the most useful superficial caustics, or substances for acting caustically on the exterior of an animal, which can possibly be employed. It has strong affinity for water, and in consequence readily combines with the fluids belonging to the part to which it is applied, so that it becomes sufficiently diluted to be incapable of producing any deep or corroding sore. It also changes the colour of the part to which it is applied, and therefore so accurately marks the extent of its application as to afford a minute and unerring guide to the surgeon in its use. For warts, foul in the foot, cankered foot, and some stubborn and morbid wounds, chloride of antimony is a valuable stimulant and caustic.

ANTIRRHINUM. See **SNAPDRAGON**.

ANTISEPTICS. Some varieties of vegetable matter, and the greater number of the animal products, are liable to a series of spontaneous decompositions, from the reaction of their elements, which constitute the process of putrefaction. The intermixture of certain substances counteracts these changes, renders them more slow, or altogether prevents them: these are named Antiseptics. The power of a number of bodies belonging to this class has been long known from popular use. The applications of sea-salt, of nitre, of vinegar, and of ardent spirits, to preserve animal substances untainted, are among the common practices which have been in use from very remote periods: and the antiseptic quality of a number of aromatic substances, resins and camphor, has led to their employment in embalming, and in some similar processes. The most extensive series of experiments on the powers of antiseptics, are those which were made a number of

years ago, by Sir John Pringle, and published in the 46th volume of the 'Philosophical Transactions.' Though sea-salt is the substance most generally used, perhaps, as an antiseptic, it does not, according to these experiments, derive this from any superiority of power; for it is inferior to many others; but is rather preferred, from its communicating no unpleasant taste or other quality to the substances which it preserves. Taking this salt as a standard, and stating its power of preserving animal matter, such as flesh, from putrefaction at 1, the comparative powers of other salts are stated in the following table:

Sal gem,	1 +	Nitre,	4 +
Vitriolated tartar,	2	Salt of hartshorn,	4 -
Spirit of mindererus,	2	Salt of wormwood,	4 +
Soluble tartar,	2	Borax,	12 +
Diuretic salt,	2 +	Salt of amber,	20 +
Sal ammoniac,	3	Alum,	30 +
Saline mixture,	3		

A number of vegetable substances even exceeded these in antiseptic power. Myrrh Sir John supposed to be 30 times more powerful than sea-salt; several bitters, such as serpentaria, chamomile, or Peruvian bark, he inferred, exceed it 120 times; flesh remaining long untainted, when immersed in their infusions: and camphor he calculated to be the most powerful perhaps of any antiseptic, its power, compared with that of sea-salt, being stated as 300 to 1. These experiments, however, cannot be regarded as altogether free from fallacy. It was in particular found that the different substances did not possess the same comparative antiseptic powers, with regard to different kinds of animal matter. Much, too, depended on the proportions employed; as is well shown by a singular fact, that some substances, such as sea-salt, which in a large proportion resist putrefaction, actually favour it when mixed in a smaller proportion. Some of the gases, especially nitric oxide, are powerful in resisting putrefaction; and several of the metallic salts, as nitrate of silver, or corrosive muriate of mercury, are used in preserving objects of natural history from the animal kingdom, from their high antiseptic power.

Little satisfactory has as yet been advanced with regard to the theory of the action of antiseptics. It is sufficiently obvious, that whatever is unfavourable to the exertion of the mutual affinities of the elements of the animal matter, must have a tendency to preserve its composition, and of course must retard putrefaction. Hence the reason why that process is checked by cold, and also by exsiccation. But it is not easy to explain, on this principle, how many of the substances, which act as antiseptics, operate. There is no obvious operation, for example, of sea-salt on animal matter, nor any known chemical agency of it, from which it could be inferred, that it would exert any such quality. The power of camphor, and other vegetable antiseptics, has been supposed to be owing to their effluvia being destructive to the ova of insects: they probably



[illegible]

in part operate by this in preventing the destruction of animal matter; but this is obviously different from their real antiseptic power, which the experiments of Pringle prove they possess. Those of them which contain tannin may operate from this principle, entering into combination with the gelatin and albumen of animal matter; and perhaps, in the greater number of cases, their action is to be ascribed to combinations of this kind being established.

Of late years, it has been discovered that the aluminous salts are eminently possessed of the property of preserving animal matters: their bases combining with geline to form a special compound, the acid being set free. M. Gannal found that a kilogramme (about 2 lbs. 8 oz. Troy weight) of sulphate of alumina, dissolved in two quarts of water, was sufficient, in winter, to preserve by injection a human body fresh for three months. The salts of alumina might doubtless be used with great advantage as external applications, in all cases requiring the topical employment of antiseptics. Chlorine, chlorinated lime, and creasote are all powerful antiseptics and disinfectants. Charcoal, mixed with crumbs of bread or linseed meal, and applied in the form of a poultice, forms a valuable application to fetid ulcers. See articles CHLORINE, DISINFECTANTS, PUTREFACTION.

ANTISPASMODICS. Medicines which counteract spasms in animals, and have a tendency to alleviate or cure spasmodic habits or affections. Opium is the most powerful antispasmodic, and is exceedingly serviceable in cases of locked jaw. Oil of turpentine is almost a specific for spasm in the bowels of the horse; and various essential oils exert a general antispasmodic tendency. But camphor, assafoetida, and various other substances which operate as antispasmodics in the human subject, have a very doubtful effect on the horse, or may be considered as very nearly inert.

ANYCHIA. A small genus of herbaceous plants of the Amaranth tribe. The forked species, *Anychia dichotoma*, grows to the height of 6 inches, and is a biennial weed of North America.

APARGIA. A genus of perennial, herbaceous, weedy plants, of the composite family. The species are fourteen in number, all natives of Europe, growing to the height of six or twelve inches, carrying yellow or orange flowers, and possessing a close resemblance to dandelion. Two of the species, the autumnal and the rough, grow wild in Britain, the former on meadows and ordinary pastures, and the latter on pastures with a chalky soil; and one, the dandelion-leaved, grows wild on the lofty mountains of Scotland.

APATITE. Native or mineral phosphate of lime, of similar composition to bone earth. It is distributed in minute proportions through every fertile soil; and occurs in a crystalline form in many kinds of rocks. It constitutes small crystals in granitic portions of plutonic and volcanic rocks, as in the mines of Johann, Georgenstadt,

and Schneeberg, in Germany, and in the loose granitic gravel in the vicinity of Berlin; it occurs in small crystals in the syenite of Meissen, and in large crystals in the syenite of Friedrichswern in South Norway; it is found in hypersthene at Elfdalen in Sweden, at Lobau in Saxony, at Tuhlowitz in Bohemia, and at Meiches in the Vogelsberge,—and in the last of these districts, which is celebrated for large and valuable produce in wheat, the proportion of it is comparatively large; it is found in the trap rocks of Wickenstein, Hamburg, Cabo de Gata, Laacher See, and other places; it occurs in various metamorphic rocks, particularly talcose and chloritic schists; it occurs in large yellow crystals in the micaceous schists of Snarum in Norway; it is found in the calcareous deposits of Pargas in Finland and of the Lake Baikal, and in deposits of magnetic iron ore in various places in Sweden and Norway; and it occurs in the limestone strata of Amberg and other places, and in the chalk formations of Cape la Hève at Havre, and Capes Blancnez and Grisnez at Calais. See LIME and PHOSPHATES.

APERIENTS. Medicines which are gently purgative, or which tend to keep the bowels of animals gently open. The principal ones used in veterinary practice are aloes, castor oil, epsom salts, and glaubers' salts.

APHIANANTHE. A little Brazilian weed, of the Amaranth tribe, and very closely allied to the annual cockscomb of the greenhouses. It constitutes a genus, comprising only one species.

APHERNOUSLI. The Siberian pine,—*Pinus cembra*. See PINE.

APHIS,—popularly *Plant-louse*. An exceedingly extensive, generally diffused, and wonderfully numerous tribe of minute insects, of the order homoptera. Dr. Leach treats them as a tribe or family, under the name of aphides, and divides them into the two genera of aphis or plant-louse, and eriosoma or blight-bug,—the latter genus comprising about one-fifth of the number of species comprised in the former; but they are treated as strictly one genus by Linnæus, and by all naturalists from his time to that of Dr. Leach,—they are capable of subdivision into at least four groups, by marks nearly as distinct as those of the group eriosoma,—they possess as little diversity throughout their entire numbers as each of several genera which have never been divided,—they are all known to the farmer and the gardener under the common name of plant-louse, blighter, or blight-bug,—and they therefore require, for every purpose of distinctness and utility, to be treated as strictly one group. The name aphis means in Greek a bug, and is derived from a word which signifies to suck a plant; and the name aphides may be regarded as its plural. The name plant-louse seems to have been suggested by a fancy, that the aphis infests plants in a similar manner to that in which the louse infests man; and the name blighter or blight-

bug alludes to the fact that the aphid causes many of the most destructive varieties of the mischiefs and desolations of plants which have long been popularly termed blights.

The aphides are vastly more multitudinous, and far more generally and minutely diffused than any other tribe of insects; they inflict enormous damage upon the hop-grower, entail many serious evils upon the general farmer, are principal pests and tormentors of the gardener, and perpetrate devastations in temperate latitudes, which correspond in some degree to the devastations perpetrated by locusts in warmer countries; and yet they are individually minute and insignificant,—they are rarely so large as a medium-sized louse, and often appear to the naked eye mere moving points,—they form fine subjects of microscopic observation, and disclose gorgeous tints, wonderful organisms, and an astonishing economy to the pocket magnifier,—and they constitute the microscopic world of animated being, the crowded communities of the leaves of the forest and the grasses of the field, the paradisaical inhabitants of the perfumed and honeyed interior of flowers, the wonderful counterparts on plants of animalcules in water, of which popular natural history has written so many glowing descriptions, and the fancy of many thousands of young learners have formed such vivid and exaggerated conceptions. The aphides inhabit every kind of plant, from the smallest grass to the most stately tree; and sometimes exist in myriads upon a single herb, of only two or three feet in height. Their species were supposed by naturalists of the last century to correspond in number and adaptation to all existing genera of plants; and, though only about seventy have been accurately observed and scientifically described, they possibly—if varieties or minor specific differences be included—do not fall short of twelve or thirteen hundred. Some of the species inhabit several or even numerous genera of plants; and other species are separated from one another in distribution among mere varieties of one species of plant; but by far the greater number occur in strict appropriation of a distinct species of the insect to one precise and exclusive genus or species of plant,—each variety of the insect having its own distinct plant, and receiving from it the specific name by which it is known in science.

The feet or tarsi of all the aphides are two-jointed, the first joint very short, and the last vesiculous; the mouth has the form of a sucker or haustellum; and the ears or antennæ have six or seven joints. The body of the larger division—or of the aphides proper as distinguished from the eriosomæ—is soft and oval; the head is small and placed crosswise; the eyes are entire and semiglobular; the ears or antennæ are larger than the body, often bristle or thread shaped, sometimes thickened towards the tip, and comprising seven joints, the two at the base very

short, and the next very long and cylindrical; the sucker or haustellum has three distinct joints, and rises from the under part of the head between the forelegs, nearly perpendicular to the body; the wings, when evolved, are four in number, the upper pair or elytrella longer than the under pair, and somewhat triangular; the legs are very long and slender, and occasion the gait of the insect to be awkward; and the rump on each side above the vent has two hollow, immovable, horn-like members, which serve to discharge the curious sweet liquid popularly called the honey dew. Fifty-seven species of this great division have been scientifically described; and 21 of these have the ears or antennæ long and tapering like a bristle, ten have the ears not tapering but thread-like, and twenty-six possess neither of these characteristics, yet have not been observed to exhibit any features which might constitute marks for classified subdivision. The body of the eriosoma or blight-bug division is usually covered with a light silky or cottony down; the abdomen has neither rump-horns nor tubercles; and the ears or antennæ are short and thread-shaped. We need hardly remark that these generic characters of aphid, as well as the subordinate characters which mark the various species, are ascertainable only by microscopic observation.

Almost all the well ascertained species possess interest, either direct or indirect, for the farmer and the gardener; and—in spite of both the tediousness and the dryness of the detail—they require, or at least well deserve, to be severally indicated.—The oat plant-louse, *Aphis avenæ*, has a prevailing greenness of colour; the members of its rump and the joints of its legs are black; its head and the first joint of its ears are yellow; its eyes are black; its legs are livid; and its tail has a bristle. This species is found in the ears of oats, barley, wheat, and rye; and it is supposed by some writers to be the cause of the remarkable excrescence called ergot or spur. See *Ergot*.—The cabbage plant-louse, *Aphis brassicæ*, is one-twelfth of an inch in length; and its general colour, when unwinged, is pale slaty gray, with a white mealy down over the body, and, when winged, dark green, with the head, eyes, and wing-ribs black. This species is found on cabbage, turnips, broccoli, cauliflower, mustard, and similar plants; and commences its ravages about the end of May or beginning of June, and continues them till checked by the frost. It made fearful ravages upon cauliflower in 1826, upon cabbages in 1833, and upon turnips in 1827 and 1836; and it may usually be seen in myriads under cabbage-leaves in July, and hid in the leaves of the crumpled broccoli so late as the end of November. Yet the *Aphis brassicæ* as a species must be understood as including several varieties. The male of it greatly magnified, is represented in *Plate XVI. Fig. 1*; the natural dimensions of the male in *Fig. 2*; the female in *Fig. 3*; and its natural size in *Fig. 4*. The cheapest

and most facile means of destroying the *Aphis brassicae* is soap-suds.—The apple-leaf plant-louse, *Aphis pomi*, has prevailingly a yellowish-green colour; its ears and legs are blackish-brown; its head, tail, bristle, and rump-horns, are black; and its eggs are black and oval, and are deposited on the spurs of apple-tree branches in October, and hatched at the budding of the leaves in spring. The best means of destroying this species is soap-suds, mixed with tobacco-water.—The pea plant-louse, *Aphis pisi*, when unwinged is of a yellowish-brown colour, and, when winged, is green, and has its wings transparent. This species is often very destructive to pease, and is most effectively combated by cutting off the shoots and leaves which it attacks; but it is frequently destroyed by a small ichneumon which deposits an egg in its body.—The vetch plant-louse, *Aphis viciae*, has a prevailingly green colour, and is found on several species of vetch.—The currant plant-louse, *Aphis ribis*, has a prevailingly shining-green colour; but its eyes are black; its legs are brown; its ears are as long as its body; and its tail is blunt. It makes the under side of currant leaves pucker up into yellowish or reddish blister-like protuberances; it appears singly, or in pairs on leaves during two or three weeks in spring; and it afterwards emigrates to younger leaves, and appears upon them in incredible numbers till about the middle of June or July. The best method of combating it is to pick off the leaves which it attacks.—The plum-leaf plant-louse, *Aphis pruni*, has a prevailingly greenish colour; its ears and legs are green; its abdomen is raised, plaited, and dotted on the edge; its tail is pointed; and its rump-horns are thread-shaped. This species infests and often grievously damages the leaves and young shoots of plum, apricot, and nectarine trees, and may be combated either by picking off the leaves which it attacks, or by assailing it with a mixture of soap-suds and tobacco-water.—The oak-shoot plant-louse, *Aphis quercus*, has prevailingly a brownish-black colour; its ears and the joints of its legs are a rusty-brown; its body is comparatively large; and its sucker is very long. This species is represented in *Plate XVI. Fig. 5*, of its natural size, and with its sucker bent under it; and in *Fig. 6*, greatly magnified, and with its sucker projecting.—The rose plant-louse, *Aphis rosae*, is of a green colour; its ears and rump-horns are tipped with black; its ears are very long; and its tail is pointed, but has not a bristle. It infests the leaves and young shoots of rose plants, and greatly damages the florification; but it is easily destroyed by a washing of soap-suds and tobacco-water.—The spindle-tree plant-louse, *Aphis euonymi*, has a prevailingly dark or black colour; its legs are pale, with black joints; its wings are transparent, with a brown spot on the outer edge; its abdomen is brown, with elevated and punctured edge; and its tail-bristle is as long as its rump-horns.—

The juniper plant-louse, *Aphis juniperi*, is variegated in the body, and has short, thick, and abrupt rump-horns. The wormwood plant-louse, *Aphis absinthii*, found on wormwood and mugwort, has a prevailingly black colour; its back is grayish, with a large brown spot; and its tail-bristle is erect.—The willow plant-louse, *Aphis salicis*, has a prevailingly black colour; its abdomen is dotted with white; and its rump-horns are yellow. This species is stronger and larger in the body than most of the aphides, and is able to attach itself to the bark of the willow. A representation of it is given in *Fig. 7*.—The turnip-leaf plant-louse, *Aphis rapae*, is nearly allied to the cabbage plant-louse, but can readily be distinguished by its long tubes, and the small apical cells of its wings. The head of the male is blackish; its collar is ochreous and brown; the disc of its thorax is shining black; its abdomen is greenish; its spiracles or breathing-pores are brown; its tubes are long and slender; its wings are iridescent, and have light brown nervures; and its feet, its claws, and the tips of its thighs are black. The female is bright green shagreened, and has fuscous horns. This species abounds on the leaves of the English turnip in the latter part of summer; it infests carrots, beet, spinach, tomato, and some other plants; and it is now pretty widely accused of causing the potato-rot, and has thence begun to be designated the destroyer or *Aphis vastator*. The male of it greatly magnified, is represented in *Fig. 8*; the natural dimensions of the male in *Fig. 9*; the female, greatly magnified in *Fig. 10*; the natural size of the female in *Fig. 11*; and a leaf infested with it in *Fig. 12*.—All the species now enumerated belong to the division with bristle-shaped antennæ; and the other species of that division are *A. viburni*, *A. althaeae*, *A. cardui*, *A. millefolii*, *A. papaveris*, *A. sonchi*, and *A. tanacetii*.

The maple plant-louse, *Aphis aceris*, remarkable for the very large proportion of honey-dew which it sheds, has a prevailingly brown colour; its ears and shanks are pale; its corselet is cylindrical, narrower than the abdomen, and thick at the sides; its abdomen is keeled, with the sides plaited; and its tail is blunt.—The alder plant-louse, *Aphis alni*, has a prevailingly yellowish-white colour; its abdomen has tubercles; and its eggs are green and covered with a whitish powder.—The orache plant-louse, *Aphis atriplicis*, found on the tops of *Atriplex hortensis*, has a prevailingly glossy-black colour; its shanks are pale; its corselet is nearly blunt; its abdomen is plaited at the sides; and its tail is blunt.—The birch plant-louse, *Aphis betulae*, has a mixedly green and black colour; its head and corselet are black; its abdomen is green tipped with brown; its legs are black; its shanks are pale; its rump-horns are green and short; and its wings have three black bands and greenish wingribs.—The pine-leaf plant-louse, *Aphis pineti*, found on the leaves of the Scotch pine, is prevailingly black;

its body is dusted over with a kind of white powder; its hind legs are long and fringed; and its eggs are black and shining.—The pine-branch plant-louse, *Aphis pini*, found on the young shoots of the Scotch pine, and forming a kind of galls like small pine cones, has a grayish-brown colour mingled with red; its body is one-sixth of an inch in length; its rump-horns are short and teat-like; its belly is yellowish-brown; and its eggs are glossy black and oblong.—The oak-leaf plant-louse, *Aphis roboris*, has a prevailing black colour; its ears are livid and tipped with black; its thighs are rusty-red; its body is large and somewhat globular; and its abdomen has very short horns on the middle.—The dock plant-louse, *Aphis rumicis*, is prevailing black; its ears and shanks are pale; its body is opaque; its abdomen is raised and plaited; and its tail is furnished with a short bristle.—The linden plant-louse, *Aphis tilie*, has a prevailing greenish-yellow colour with black dots; its ears and legs are variegated with white and black; its corselet has a black lateral line on each side; its abdomen is blunt, with four lines of black dots; and its eggs are black and covered with a white down.—The elm plant-louse, *Aphis ulmi*, has a prevailing rusty-black colour; its body is covered with longish white down; its ears are very large; its wings are transparent and very long, and have a small brown spot at the outer edge; and its rump-horns are indistinct. The ten species now enumerated are those whose ears are not tapering, but rather thread-shaped.

The bean plant-louse, bean-dolphin, or collier, *Aphis fabæ*, has a deep black colour, and has become familiar to the most common observer from its swarming on the tops of bean-plants about the time of their beginning to pod. It infests the tops of all varieties of beans, spinage, and several other plants, and is very destructive to crops. Whenever it appears, the tops of all the plants in a bed, division, or field ought to be cut off into a receiving vessel with a sharp knife or a pair of scissors; and if it reappears, another section of the tops of all the plants ought to be cut off.—The hop plant-louse, *Aphis humuli*, has a prevailing green colour; its ears and rump-horns are tipped with black; and it closely resembles the rose plant-louse, but is smaller. It is found—not, as is usually asserted, on previously diseased plants,—but on the youngest and healthiest leaves and shoots of the hop. In many years, it inflicts great and extensive injury upon the hop crop; in some years, as in 1793 and 1798, it caused the entire crop to fail; and, in spite of the hop grounds being confined to portions of only two or three counties, it has occasioned to the hop-growers of England the loss of very many thousands, we might perhaps say millions, of pounds sterling. Syringing with soap-suds and tobacco water is a partial remedy; topping, as in the case of the bean plant-louse, would be quite effectual, but would damage the plants; and a really good

and thorough remedy has yet to be invented.—The carrot plant-louse, *Aphis dauci*, has a prevailing dark yet diversified colour; its ears are black, but pale at the base; its head and corselet are brown; its abdomen is green, with a black blotch at the tail; and its legs are black. It occurs on the umbels of carrot plants, and prevents or damages the formation and ripening of the seed. As soon as it is observed, it ought to be assailed with soap suds and tobacco water.—The gooseberry plant-louse, *Aphis grossulariæ*, is of a light green colour when young, and of a dark green colour when old. It appears on the twigs and leaves of the gooseberry plant in April, and is sometimes very destructive of the fruit. The common people in the middle districts of Yorkshire imagine the swarms of it to be occasioned by the smoke of Leeds. It may be partially destroyed by soap-suds and tobacco water; but is more effectually combated by picking off the infected leaves.—The cherry plant-louse, *Aphis cerasi*, has prevailing a glossy black colour; its shanks and the middle of its ears are pale; its corselet is reddish brown above, and quite red beneath; its fore-feet are pale; its other feet are black, with white spots; and its body is stout, plump, and egg-shaped. It infests the leaves of the cherry-tree, and generally inflicts great damage. It commences its devastations about the end of April or beginning of May; it rapidly multiplies from that time till June; and it then leaves the trees and does not reappear till September. All trees attacked by it ought to be syringed with soap-suds and tobacco water.—The lettuce-root plant-louse, *Aphis radicis lactuæ*, has a greenish-white colour, and is comparatively large and plump. It occurs under ground about the crown of the roots of lettuce and endive; and is most abundant in autumn. A community of ants usually environ the roots attacked by it, in order to feed on its honey dew; and they contribute even more powerfully than itself either to ruin the plants or at least to prevent them from seeding. See article ANT. Soap-suds ought to be copiously poured, and the soil firmly trodden in, around the roots of all infected lettuces and endives.—The currant-root plant-louse, *Aphis radicis ribis*, is comparatively small in size, has a buff or flesh colour, and is covered with a sort of cottony down. It attacks the roots of currant leaves, and causes the leaves to fall, from the middle of July till the end of September; and it then becomes winged and migrates. It is best combated by soap-suds and the treading in of the soil.—The vine plant-louse, *Aphis vitis*, has a prevailing greenish colour; its abdomen is brown on the back; and it has a brown dot between the ears. It works great havoc upon the vines of vinous countries, but probably has not found its way into Great Britain.—The zebra or elder-tree plant-louse, *Aphis sambuci*, is comparatively large in size, and has a prevailing black colour, with three white streaks on each of its sides; and the base of its

abdomen has a small dot on each side, and a single dot near the tail.—The raspberry plant-louse, *Aphis rubi*, is one of the largest of the plant-lice; it makes its attacks about the time of the raspberry fruit being ripe; and, as it cannot be destroyed, it often makes great devastation.—The sawfly plant-louse, *Aphis capreae*, found on the *Salix caprea*, has a prevailing green colour, which becomes pale at the sides; its eyes, its ears, and the tips of its legs are black; and its abdomen is pointed.—The chief of the remaining well-ascertained aphides, not belonging to the eriosoma or blight-bug division, are the sorrel aphid, black with a green band, and inhabiting the common sorrel; the ashweed aphid, black, and inhabiting the *Agopodium podagraria*; the blue-vetch aphid, inhabiting the *Vicia cracca*; the sow-wort aphid, inhabiting the *Serratula arvensis*; the knapweed aphid, with black body, white wings, and brown tail, and inhabiting the *Centaurea jacea*; the lettuce aphid, green, and inhabiting the leaves of the garden lettuce; the mandarin aphid, with black head and corselet and greenish sucker and abdomen, and inhabiting the *Chrysanthemum leucanthemum*; the lovage aphid, comparatively large, dark in colour, very long in the ears, thickened and punctured in the sides, and inhabiting the common lovage; the lampwort aphid, black, and inhabiting the *Lychnis dioica*; the water-lily aphid, prevailing green yet variegated, and inhabiting various kinds of aquatic plants; the bird cherry aphid, inhabiting the hawberry or bird cherry tree; the parsnip aphid, inhabiting the garden parsnip; the plantain aphid, inhabiting the young stems of the plantain; the primrose aphid, laying eggs which change from green to black, and inhabiting the auricle, the polyanthus, and some other species of primula; and the scabiose aphid, inhabiting devil's bit and other species of scabiosa.

The woolly blight, American blight, white blight, or apple blight bug, *Eriosoma mali*, *Aphis lanigera*, or *Aphis lanata*, is one of the most remarkable and mischievous species of the whole of the aphid family. It infests apple trees, and sometimes reduces entire orchards to sterility. It is of comparatively middle size, and has a pitch brown colour, but envelops itself in a white silky down. In spring, a slight hoariness appears upon the branches of infested trees; as the season advances, this hoariness increases and becomes cottony; and about the middle or toward the end of summer, it looks like a vestment of thick down upon the lower sides of the branches, and is sufficiently long and pendulous to be at times sensibly agitated by the air. A multitude of small wingless insects, the woolly or American blight-bugs, will be found, on examination, to lie concealed in this downy substance, and to be preying beneath it upon the bark and juices of the tree. The alburnum or sap wood, being wounded by them, rises up in excrescences and nodes; the branch, deprived of its nourishment, becomes sickly, loses

its leaves, and perishes; branch after branch is assailed, becomes leafless, and dies; and finally the stem and roots, deprived of every connexion with living leaf and branch, decay beyond all reach of remedy. In autumn, the insects are dispersed by the winds and rains, and secrete themselves in the crannies of any neighbouring substance. "Should the savoy cabbage be near the trees whence they have been dislodged, the cavities of the under sides of its leaves are commonly favourite asylums for them. Multitudes perish by these rough removals, but numbers yet remain; and we may find them in the nodes and crevices, on the under sides of the branches, at any period of the year, the long cottony vesture being removed, but still they are enveloped in a fine, short, downy clothing, to be seen by a magnifier, proceeding, apparently, from every suture or pore of their bodies, and protecting them in their dormant state from the moisture and frosts of our climate. This aphid, in a natural state, usually awakens and commences its labours very early in the month of March; and the hoariness on its body may be observed increasing daily; but if any infected branch be cut in the winter, and kept in water in a warm room, these aphides will awaken speedily, spin their cottony vests, and feed and discharge, as accustomed to do in a genial season." This very destructive aphid, greatly magnified, is represented in *Fig. 13, Plate XVI.*; and an apple-branch infected with it, is represented in *Fig. 14*. Numerous methods of destroying it have been proposed and tested; but some are expensive, some are very dirty, and some are either wholly or partially inefficient. The best of the methods, as to at once cheapness, cleanliness, and efficiency, are syringing with soap-suds and tobacco water, minutely brushing with spirits of turpentine, brushing with a mixture of three parts of soap-lees and one of oil of turpentine, and brushing with brown impure pyroligneous acid.

The plum blight-bug, *Eriosoma pruni*, is often confounded with the American or apple blight-bug, but is a perfectly distinct species, and infests the younger branches of plum, apricot, nectarine, and peach trees. It passes the winter in chinks and cracks of the bark of the trees, multiplies prodigiously in spring, and often renders the fruit of the trees not worth gathering. The methods for destroying the apple blight-bug will be equally efficacious against the plum blight-bug; but they ought to be kept from contact with the fruit.—The ash blight-bug, *Eriosoma fraxini*, found on the branches of the ash-tree, has a mixedly green and black colour; its abdomen is green, but has the edges black; its head and its corselet are black; and its ears and legs are variegated.—The pine blight-bug, *Eriosoma pineti*, found on the Scotch pine, has prevailing a black colour, concealed beneath a covering of white mealy down; and its hind legs are long and fringed.—The purse blight-bug, *Eriosoma bur-*

saria, found on the leaves of the black poplar, and causing them to take the form of a purse, is of a dull brown colour, somewhat translucent; its sides are gibbous; and its ears are short.—The aspen blight-bug, *Eriosoma populi*, found on the rolled leaves of the aspen tree, is diversified in colour; its head and its corselet are black; its abdomen is greenish; and its wings are white, with the outer margin black.—The nettle blight-bug, *Eriosoma urticæ*, found on the stems and leaves of the common nettle, has a prevailing black colour; its abdomen exhibits a brazen hue; its wings are white, with parallel black veins; its wing-rib is brown; its legs are black; and its tail has an abrupt bristle.—The principal other well-defined aphides of the blight-bug or eriosoma division, are the hawthorn blight-bug, comparatively small, discharging a profusion of honey dew, and inhabiting the shoots and young leaves of hawthorn plants; the beech blight-bug, inhabiting the leaves of the beech tree; the spruce blight-bug, inhabiting the branches of the spruce fir; the elm blight-bug, inhabiting the rolled leaves of the elm; and the honeysuckle blight-bug, inhabiting the honeysuckle plant.

The aphides, in their economy of pairing and reproduction, are the most remarkable animals yet known. Bonnet, Bazin, Reaumur, Trembley, Lyonnet, and other naturalists, ascertained, by experiment and observation, some facts in this economy so wonderful as to be utterly incredible except on high and complicated authority. Bonnet selected a plant-louse which he had seen born the instant before of a mother without wings, and placed it upon a leafy spindle-tree branch, which he had carefully and minutely ascertained to be free from the presence of any other individual aphid. He fixed the branch with the insect in a phial of water, placed the phial in a garden-pot of mould, covered the whole with a glass vessel, and so completely buried the edges of the vessel in the mould that there could not possibly be any communication between the imprisoned insect and the external world. He commenced his experiment on the 20th of May; and day after day, he hourly, from five in the morning till nine or ten at night, watched the insect with a magnifying glass; and he found that it four times changed its skin, and grew like a caterpillar, that on the 1st of June it produced a living young insect, and that, from that date till the 22d of the same month, it brought forth ninety-five young insects. Bazin made similar experiments and observations upon the poppy plant-louse and the rose plant-louse, and found them also to produce progenies of young without having paired. Trembley put an elder-tree plant-louse on a slip of elder, enclosed this in a glass tube, plunged one end of the tube in water and plugged the other with cotton, and found the insect about two months after beginning to produce young, and subsequently producing more at intervals according to the temperature of the atmosphere.

Trembley's breeding apparatus is shown in *Fig. 15, Plate XVI.*, Reaumur's in *Fig. 16*. Bonnet, not contented with his first experiments, instituted a new series, and ascertained that at least five generations of the elder-tree plant-louse, and no fewer than nine generations of the oak plant-louse, may be produced without any pairing. Lyonnet afterwards confirmed these ulterior observations of Bonnet; and Duvan observed some individual plant-lice during seven consecutive months, and found eleven generations to be produced without pairing. This extraordinary and truly wonderful fecundity of female aphides, however, becomes exhausted; and pairing becomes as indispensable for its renewal as it is for the reproduction of any other animal. Yet the female, after having paired, does not produce living young but eggs or a kind of pupæ resembling eggs; the insects evolved from the eggs produce living young ones without pairing; all the young of successive generations till the approach of pairing time are females; and in autumn or at the close of summer, when fecundity is exhausted and pairing becomes necessary for its renewal, some males are produced. How mighty and glorious are the evidences of the Divine skill and superintendence throughout each of the infinite diversities of organism and economy among creatures!

The rapidity with which the aphides multiply is almost as astonishing as their peculiar mode of generation. Calculating on the data of Bonnet's observations, reckoning 90 for the first generation from a single mother, and supposing that each individual will be equally prolific with the parent, the second generation will amount to 8,100, the third to 729,000, the fourth to 65,610,000, the fifth to 5,904,900,000, and the ninth to 350,970,489,000,000,000. Yet several naturalists estimate the increase at considerably greater rates; and Dr. Richardson, in particular, calculates the ninth generation to amount to 25,065,093,750,000,000,000, and does not include in this number the generation of pupæ immediately before winter for the renewal of the race or progeny of the following season. Major records that, in September, 1829, he saw swarms of the apple bug-blight alighting in clouds, and covering every kind of tree or plant within the space on which they alighted; and White of Selborne says, "On the first of August, about half-an-hour after three in the afternoon, the people of Selborne were surprised by a shower of aphides which fell in these parts. They who were walking the streets at that time found themselves covered with these insects, which settled also on the trees and gardens, and blackened all the vegetables where they alighted. These armies, no doubt, were then in a state of emigration, and shifting their quarters, and might perhaps come from the great hop plantations of Kent and Sussex; the wind being that day at north. They were observed at the same time at Farnham and all along the vale at Alton."

The mother plant-lice, after producing a full generation of young aphides, become smaller and flatter than before, and, in probably all instances, very soon die. Some species—perhaps nearly all the species—of aphides pass the winter only or chiefly in the egg-state, all the perfect insects dying about the commencement of winter, and the progeny of the next year being hatched by the heat of spring. Yet just as female wasps and female humble bees, after having paired in autumn, and survived all the males, find shelter during winter, and remain ready to bring forth a numerous progeny in spring, so many of the perfect aphides pass the winter in sheltered places, and find all the scanty nourishment which they require either from the perennial portions of their own proper plants, or from plants of similar character or juices to their own. In Sweden, where the cold of winter is much more severe than in England, the *Aphis pini* lives through the winter on the branches of pines; and both in England and on the continent, females of the several species which feed on ligneous plants may, by any careful and minute observer, be seen, in the very middle of winter, in the chinks or cracks of the branches of trees. "Towards the end of December and the beginning of January," says Reaumur, "I have seen several plant-lice on the buds of young shoots on a peach-tree, after some days of severe frost. These were wingless females, very plump, and full of young." Even species whose normal plants are herbaceous and either annual in cultivation or perennial only in the roots, seem to have little difficulty in temporarily accommodating themselves even in summer upon other plants, or in finding during winter all the scanty nourishment which they require. Several species of our native plant-lice may almost constantly, both in summer and in winter, be seen infesting the tender exotic plants of our rooms and our green-houses. The bean dolphin, even when plenty of fresh bean plants are in the immediate vicinity, may be occasionally seen spread over a bed of spinage or dispersed among plants of the goose-foot family; the cabbage aphis may often be seen upon mustard plants, and sometimes upon radishes; and the rose aphis may occasionally be observed upon lavateras, chrysanthemums, and pelargoniums. All attempts to combat or exterminate aphides, therefore, ought to be conducted on the assumption that fertile females may be found in considerably different situations from their normal ones, and may even retain their vitality and be maturing their fecundity during winter.

Some entire species of aphides, and certain portions or generations of other species, appear to be migratory. All the individuals of the *Aphis humuli*, though sufficiently numerous to cover the leaves of the hop plantations in millions, have been observed, for several successive years, to disappear soon after mid-summer. The bean dolphin, the zebra plant-louse, and some other spe-

cies, are also seen to make a total disappearance at some period in summer; and though they may in some instances die on or near the place where they disappear, yet, in the majority of instances, they obviously migrate either to other districts to obtain supplies of food, or to the sea-coast to be drowned and washed away in the same manner as the locusts of oriental countries. "I once," says a naturalist, "witnessed, to my great annoyance, an emigration of aphides, when travelling in the Isle of Ely. The air was so full of them that they were incessantly flying into my eyes, nostrils, &c., and my clothes were covered by them; and in 1814, in the autumn, the aphides were so abundant for a few days in the vicinity of Ipswich, as to be noted with surprise by the most incurious observer." The provision made by the Creator in their organism and economy, for enabling them to migrate, and for regulating the time and the extent of their migrations, has the same wonderful character as the laws of their reproduction. In spring, all the aphides which appear are wingless females; as the season advances, some winged females appear and remove to a distance; in the new quarters of the winged females, most of the next generation are wingless females; and in autumn, at the appearance of the last generation of the season, most of the males are wingless to retain them with the main body of the females on the spot, and a few are winged to enable them to migrate to distant colonies. The winged insects, both male and female, pair with the wingless ones; and all the young which are destined to become winged have the elements of the wings folded up in little bunches at the shoulders, and are not practically winged till after the third or fourth casting of the skin.

The devastations of the aphides are effected by means of their haustellum, variously styled in popular language their beak, their sucker, and their mouth-sucker. The haustellum of the *Aphis querous*—which, on account of the comparative largeness of the species, may be advantageously selected to illustrate the haustellum of the whole tribe—is much longer than the body, and, when unemployed, is carried in such a manner between the legs, close to the belly, as to project behind, and look like a slightly upward curved tail. See *Fig. 5 and 6, Plate XVI*. It terminates in so minute a hole, that Reaumur could not observe it with his most powerful microscopes, and proved its existence only by pressing out from it a drop of fluid. Two instruments of a brownish colour have been observed within the tube, and were conjectured by Reaumur to act like the piston of a pump. The insects, when forcing the sucker into the bark of a plant, press down their head and elevate the hinder part of the body, and, in consequence, exert considerably more power than if they were to maintain a horizontal attitude; and, after they have pierced a hole, they continue at it night and day, without any locomotion, so long as they can obtain through it a sufficient

supply of food. They usually station themselves on the youngest shoots and the under side of the leaves of plants, apparently because these are at once the juiciest, the most nourishing, the most accessible, and the most pervious parts of the plants; and they, therefore, abstract the cambium or elaborated sap of the plants immediately after it is prepared, and prevent it from making such a descent through the downward organisms as is essential for maintaining vegetable life and the performance of the vegetable functions. Entire plants are thus robbed of their nourishment; and either the leaves shrivel up, as in the cabbage, the plum-tree, and the currant bush; or the blossoms drop, and the fruit does not set, as in the bean and the hop. The excrementitious discharges of the aphides form another remarkable and very prominent feature in their economy; but as they are often theoretically confounded, and seem to be sometimes actually blended, with certain vegetable exudations which share with them in one popular name, we reserve a full notice of them for the article HONEY-DEW: which see.

Several species of the sylviadæ or soft-billed birds, particularly the yellow wren, the gold-crest, the babillard, and a number of others, feed upon the aphides, and generally make such havoc upon the garden species that they may be emphatically regarded as the gardener's friends. The beautiful beetles coccinellæ, popularly called lady-birds and lady-cows, comprising about thirty British species, prey, in both their larva and their perfect state, most conspicuously upon the aphides, and sometimes destroy entire swarms. "Their method of attacking the aphides," says Mr. Curtis, "is curious. I have seen one of the latter struggling whilst this little insect alligator threw his fore-legs about it, and was greatly amused at the skill it exhibited; for, fearing that the aphid might escape, it gradually slid along to the wings, which were closed, and immediately began to bite them so that in a very short time they were rendered useless, being matted together; it then returned in triumph to the side of its helpless victim, and seizing the thorax firmly in its grasp, it ate into the side, coolly putting its hind-leg over those of the aphid, whose convulsive throbs annoyed its relentless enemy." The coccinellæ are often attracted in myriads to feed upon the aphides of the hop plantations, the gardens, and the orchards; and in some seasons when the aphides were unusually multitudinous, they have appeared in some districts in such enormous numbers as to alarm the ignorant and superstitious. The larva of a coccinella, of its natural size, is shown in *Fig. 17, Plate XVI.*; the same larva, greatly magnified, in *Fig. 18*; the pupa of a coccinella, upon a leaf, in *Fig. 19*; the imago of the two-spotted coccinella, in *Fig. 20*; and the imago of the seven-spotted, in *Fig. 21*. See article COCCINELLA. The grubs of hemerobidæ or lace-winged flies—easily recognisable by their slow flight, their broad, greenish, gauzy wings, their

bad odour, and their shining, amber-like eyes—are so voracious devourers of aphides as to be often called aphid-lions. The larva of one of them, *Chrysopa perla*, much magnified, is shown in *Fig. 22*, and the perfect insect in *Fig. 23*. The maggots of some syrphidæ or wasp-flies, feed on the cabbage plant-lice, and possibly on some other species of aphides; and one of these, with an aphid in its mouth, is shown in *Fig. 24*, and the perfect insect of it, *Syrphus pyrastris*, in *Fig. 25*. Some small species of ichneumons deposit their eggs in the bodies of the latter or autumnal generations of two or three species of aphides; and all the earwigs devour plant-lice, particularly such species as cause the leaves of plants to shrivel. All the aphides are easily seized by the most slowly moving perfect insects and even by their larvæ, for they make no effort to escape.—*Paper by Professor Rennie in Q. Journal of Agr.*—*Paper by Mr. Curtis in Journal of Royal Agr. Soc. of England.*—*White's Natural History.*—*Pictorial Museum of Animated Nature.*—*Virey Des Mœurs et des Instincts.*—*Journal of a Naturalist quoted in Quar. Journal of Agr.*—*The Entomologist.*—*Loudon's Gardener's Magazine.*—*Hunter's Georgical Essays.*—*Salisbury's Hints on Orchards.*—*Tredtise on Husbandry in Lib. of Useful Knowledge.*

APHTHÆ or THRUSH. A disease in the mouth of sheep and black cattle. It resembles blain or gloss-anthrax, and has often been mistaken for it, but is less severe. It consists in pustules or vesicles along the sides of the tongue, at the root of the tongue, athwart the palate, and sometimes backward to the fauces and forward to the outside of the lips; it occasionally extends and aggravates itself into a general ulceration of the mouth; and it is frequently accompanied by inability to feed, loss of appetite, and general lassitude. It often appears at the time when the foot is affected with foot-rot, and has been supposed, not without reason, to have some connexion with that disease, for the sheep, being in the habit of licking its foot when sore, may suck in some of the acrid discharge of foot-rot, and in consequence contract a pustulous condition of the mouth. Alum water, applied as a lotion to the mouth, will speedily remove the tenderness which prevents the animal from feeding; and, if promptly used as soon as the earliest symptoms of the disease appear, will effect a cure before any of the worst symptoms can have time to be developed. When a lamb is affected with apthæ, it communicates the disease to the ewe's udder, is prevented by the ewe from continuing to suck, and gradually pines away. The infected udder swells and sometimes suppurates, always making the ewe lose flesh, and sometimes occasioning one or both teats to slough, and rendering the animal useless for a stock ewe. When a flock of young and old are partially affected, the diseased ought to be promptly and completely separated from the sound, and the affected parts of the former may with advantage be dressed every morning

with a detergent mixture of half a pound of simple oxymel, six ounces of burnt alum, and two drachms of sulphate of copper. Aphthæ, especially in unusually cold and wet weather in spring or winter, is sometimes an epizootic in both sheep and black cattle; so that, whenever it appears, precautions ought to be adopted to prevent it from spreading. The disease is rarely so severe in black cattle as in sheep, sometimes healing of its own accord, seldom exciting sufficient fever to impair the appetite, and never exciting so much as to indicate any danger. It may continue during ten or fourteen days or even during a longer period; but it gradually disappears under the action of a few mild doses of physic.—*Cleeve's Prize Essay on the Diseases of Sheep in Journal of Eng. Agr. Society.*—*Spooner on Sheep.*—*Youatt on Cattle.*

APIARY. A group of garden bee-hives, or a place in which bees are kept. See **BEES**.

APION. A large genus of insects of the coleopterous order. It comprises many of the smallest individuals of the weevil tribe; and possesses a sad interest to the farmer in its devastations upon the seeds of clover. About ninety species of it have been enumerated by naturalists; but many of these can be distinguished from one another only by the aid of a microscope; and only two or three are conspicuous enough in mischief to challenge any special notice. The largest insects of the genus do not exceed two lines and a half in length, and some measure scarcely one line. Their crust is usually very hard, and not unfrequently adorned with somewhat vivid metallic tints, and sculptured with deep parallel furrows and catenulated lines. They take their name from a Greek word which signifies a pear, and present a considerable miniature resemblance to that fruit in shape; their antennæ are scarcely or not at all bent, and are inserted sometimes towards the middle, and sometimes near the base of the rostrum; the latter projects forward, and is slender, elongate, nearly cylindrical, and somewhat curved; their thorax is narrow and conical or somewhat cylindrical; and their abdomen is widest at the hinder extremity, and usually very much dilated. In their states of at once larva, pupa, and perfect insect, they feed on plants; and in the case of several of their species, they are permanently and exclusively attached to particular plants in the same appropriating manner as the species of aphides. Most feed upon leguminous plants, and certain species feed chiefly or exclusively upon the cultivated clovers, the restharrow, the meadow vetchling, and the tufted vetch. Some species feed also, in an exclusive manner, upon other plants than those of the great leguminous group, and particularly upon the common mallow and other plants of the malvaceous tribe.

Apion apricans—also called *Apion flavifemuratum*—feeds upon red clover, *Trifolium pratense*, and is considerably the most mischievous species

of apion. It usually abounds on stones and warm banks by the sides of fields, and seems to occur in all parts of Great Britain. Its length is about one line and a half; its body is black; its head is finely punctured; its rostrum is long, shining, filiform, finely punctured, and somewhat thickened in the middle; its antennæ are prevaillingly black, but yellowish at the base; its thorax is thickly punctured, and has a faint line on the back; its elytra are broadly ovate, somewhat glossy, and marked with parallel lines of punctures; its legs are black; and its thighs, the two anterior coxæ, the tibiæ, and all the trochanters are yellowish-red. Its larva is an extremely minute whitish worm, with a black head; the pupa is small, oval, and white; the skin of the pupa is so transparent that the limbs of the enclosed insect, at an advanced stage of the pupa condition, can be distinctly seen; and the perfect insect, on emerging from the pupa, is soft and white, but soon acquires its permanent colours and other distinguishing properties. The perfect insect passes the winter in a torpid condition beneath the bark of trees, among moss, under stones, and in other similar situations; and at the time when red clover is ready to flower, the female deposits her eggs on the calyx of the florets, usually placing them near the base. The larva, as soon as it is hatched, begins to eat its way through the base of the floret, and consumes the rudiment of the seed; and, when increased in size and strength, it proceeds through a series of seed-vessels, and subsists entirely on their contents. The injury inflicted sometimes amounts to the total destruction of considerably more than one half of all the clover seed of a crop, and the serious deterioration of much of the remainder by partially gnawing or by deprivation of its juices. The immediate loss of the destroyed seed falls, of course, only upon seed growers; but the eventual loss to the farmer may be very serious, partly by the enhancement of the price of seed, and chiefly by the deterioration of the portion which he purchases. The destruction of the eggs or the young larvæ by saturation of the clover heads with some pungent liquid would probably be too difficult and expensive; and, instead of it, the destruction of the parent insect in spring, might be attempted by sweeping all suspected places in and around fields with small nets sufficiently close in the meshes to catch and retain the insects.

Apion flavipes is also a very common and mischievous species, and attaches itself to white clover, *Trifolium repens*, in the same manner in which *Apion apricans* preys upon red clover. Its length is about one line and a quarter; its body and its rostrum are black and shining; its rostrum is not very long, and slightly thickened at the base and the apex; its antennæ are yellowish at the base, and inserted behind its middle; its thorax is scarcely wider than its head, thickly punctured, and marked behind the middle with a short, impressed, dorsal line; its elytra are

broadly ovate, marked with close punctured lines, and not so much inflated as those of *Apion apricans*; and its legs are yellow, the tarsi and coxæ are black, the latter parts sometimes yellow on the two anterior pair of legs. This species conducts its depredations in the same manner and with the same results as *Apion apricans*; and can be combated or destroyed only by similar means.—*Apion assimile* has a somewhat close resemblance to *Apion apricans*, and attaches itself to the *Trifolium ochroleucum*.—*Apion ononis* attaches itself to the restharrow, *Ononis arvensis*, and has been known to occasion that plant an almost total loss of its leaves.—*Paper of Rev. Mr. Duncan in Quar. Journal of Agr.*—*The Linnaean Transactions.*—*Paper of Mr. J. Walton in the Annals and Mag. of Nat. Hist.*

APIUM. See PARSLEY and CELERY.

APOCRENIC ACID. One of the acids which result from the decomposition of vegetable matter in soils. An acid closely allied to it, and usually accompanying it, but less oxygenated, is crenic acid. Both were first detected in spring water, and in consequence derive their name from a Greek word which signifies 'a fountain.' But because the French word for a spring is *source*, the crenic acid has been called by some continental chemists Sourcic acid, and the apocrenic acid has been called Oxygenated sourcic acid. Both are nearly allied to geine or humic acid, and have been identified with that substance by Dr. Liebig and Professor Graham; yet they are recognised as perfectly distinct acids by most other distinguished chemists. They are characterized, or proved to be distinct from geine or humic acid, by the presence of nitrogen; and they cannot pass into that substance without losing nitrogen, and in consequence undergoing a change of chemical constitution. Raspail, indeed, holds a middle opinion respecting them, and supposes that, in them and in gluten, nitrogen exists and acts only as an accident or as an ammoniacal salt. But it seems both more philosophical and more practically useful, to regard them as constitutionally distinct from humic acid, and as presenting nitrogenous, while humic acid presents non-nitrogenous results of vegetable composition; and, when thus viewed, they will be seen to perform an important part in those complicated chemical processes which constitute fertility of soil, or prepare its mineral and manurial elements for the absorption and nourishment of growing crops. See articles AZOTE, GEINE, HUMIN, and SOIL.

APOPLEXY. See STAGGERS.

APPEAL. A term in law which signifies the removal of a cause or suit from an inferior to a superior judge or tribunal. Of this nature were the ancient appeals to the court of Rome, in ecclesiastical matters, introduced into England along with the canon law, during the reign of King Stephen, which, though previously held to be illegal, were afterwards expressly prohibited, upon the

Reformation, by the statutes 24^o Hen. VIII. c. 12, and 25^o Hen. VIII. c. 19 and 21; whereby the party appealing from any of the king's courts to the court of Rome was made liable to the pains of *præmunire*. And this offence is made treason by 13^o Eliz. c. 2. In ecclesiastical suits, appeals lie from the archdeacon's court to that of the bishop; from the consistory court of every diocesan bishop to the archbishop of each province, or his official, in the court of arches; and from this court there lies an appeal to the king in chancery, as supreme head of the church of England. The jurisdiction of this last great court of appeal, in all ecclesiastical causes, is exercised by a court of delegates, appointed by the king's commission under his great seal. Should the king himself be a party in any of these suits, the appeal, of course, does not lie to him in chancery, but, by the statute 24^o Hen. VIII. c. 12, to all the bishops of the realm, assembled in the upper house of convocation. And although the sentence of the delegates be declared, by the statutes 24^o and 25^o Hen. VIII., to be definitive; yet, in extraordinary cases, when it is apprehended they have been led into a material error, a commission of review may be granted by the king, for the purpose of revising their judgment. This, however, cannot be demanded by the subject as a matter of right, but only as a matter of favour, which, therefore, is frequently refused.

In civil cases, appeals lie from all the ordinary courts of justice in England, and also from the equity courts of chancery, to parliament. Appeals from the courts of justice, against judgments at common law, are effected by what are called *writs of error*; those from chancery by *petition* to the house of peers. The jurisdiction of parliament, in the case of chancery suits, is said to have been introduced in 18^o Jac. I.; and certainly the first petition which appears in the records of parliament was preferred in that year, and the first that was heard and determined was presented a short time after. It was afterwards warmly controverted by the house of commons, in the reign of Charles II. But this dispute is long since at rest: it being perfectly obvious to the reason of all mankind, that when the courts of equity became principal tribunals for deciding causes of property, a reversion of their decrees, by way of appeal, became equally necessary as a writ of error from the judgment of a court of law.

Appeals from a court of equity, and writs of error from a court of law, differ from each other in these respects: 1st. The former may be brought upon interlocutory matters; the latter upon definitive judgments only. 2dly. On writs of error, the house of lords pronounces the judgment; on appeals, it gives direction to the court below to rectify its own decree.

The word *appeal* has the same signification in the law of Scotland, and is generally employed to express the act of bringing a decree of the

court of session under the review of the house of lords.

It was once warmly disputed, whether the decrees of the session were, before the union of the two kingdoms, subject to the review of the parliament of Scotland. On the one hand, instances occur in the books of sederunt, soon after the institution of the college of justice, of parties protesting for remedy of law; i. e. of their appealing from the sentences of the session to the king and parliament. On the other, the court of session disallowed this right of appealing; because their sentences are declared to have the like force as those of the old court of session, 1537, c. 39; and that old court had a power of judging finally, without appeal to parliament, 1457, c. 62. When, therefore, an appeal was offered to parliament, in 1674, against a decree of the session, the judges ordained the appellant's counsel to confess or deny, whether they had advised their client to that measure! And upon their declining to answer, the court, after debarring those advocates from the exercise of their offices, applied to the privy council, who banished, not them only, but all the other advocates who would not declare their abhorrence of such appeals, twelve miles from Edinburgh: and under this sentence many of the most eminent lawyers continued for several months, till the court, at the king's desire, restored them, upon their disclaiming the right of parties to appeal. The convention of estates, however, in 1689, c. 18, declared that the punishment of those advocates, without a trial, was a grievance; and, by c. 13, they asserted it to be the right of every subject to appeal to parliament against the decrees of the session.

Appeals, since the union of the two kingdoms, in 1707, lie from the court of session, the court of exchequer, and the commission of teinds to the house of lords. The form of entering an appeal is by presenting, after some preliminary forms before the court of session, a petition to the house of lords, praying for a warrant of service on the party in whose favour judgment was given in the court of session. By a rule of the house of lords this must be done within two years from the date of extracting the decree. The *writ of appeal* being served on the successful party, has the effect of staying execution of the sentence until the appeal be discussed by the house, or passed from by the appellant. Within fourteen days from the date of presenting the appeal, the appellant, or some responsible person for him, must enter into a recognisance to the extent of £400, otherwise the appeal falls. Thereafter, cases are prepared for the appellant and respondent, and counsel heard at the bar, when the decision is either affirmed, reversed, altered, or remitted back, with special grounds for the consideration of the court of session. Should any further procedure be necessary, a petition may be presented to the latter court, requesting the judgment may be applied.

Appeals also lie from the inferior courts in Scotland to the circuit court of the district, in such criminal causes as infer neither death nor demembration, and in civil causes, where the subject in dispute does not exceed £12 sterling. These appeals must be lodged with the clerk of the inferior court within ten days after pronouncing the decree appealed from. But no appeal lies before a final decree has been pronounced by the inferior court. In the sheriff-courts of Scotland, any judgment of the sheriff-substitute, whether interlocutory or final, may be appealed to the sheriff-depute within six free days after the date of the interlocutor; but no reclaiming petition is competent against a judgment pronounced on appeal.

Appeals are not competent from the court of justiciary, nor from the verdict of a jury.

APPETITE. A desire to eat, combined or accompanied with an uneasy or painful sensation in the stomach. A regular appetite is generally indicative of good health; and either a feeble appetite or a voracious one is indicative of derangement of some of the organs or debility of the whole constitution. When a horse has a feeble appetite, or in common phrase a want of appetite, he eats an insufficient quantity of food, mangles his hay or leaves it in the rack, loses flesh or at least acquires very little, and discharges pale and habitually soft excrement. The relaxed state of constitution, or weakened condition of the organs of digestion, which is indicated by these appearances of feeble appetite, may either be hereditary, or habitual, or the effect of using too much hot meat, or of other improper management. A good method of treatment, when the feebleness of appetite is hereditary or habitual, is to give him much gentle exercise in the open air, to confine him as much as possible to a dry diet, to beware of oppressing his stomach with large seeds, to indulge him with an occasional handful of beans among his oats, and in general to give him light, dry, grateful, nourishing food, and a constant and free supply of pure air. If he do not speedily improve under this treatment, or if he appear to suffer uneasiness in his bowels, he ought to receive a few gentle purges, followed by aromatic drinks. But when the feebleness of appetite is occasioned by too much feeding, especially scalded bran or other hot diet, the best treatment is to bleed and purge the horse, and at the same time to rowel him in the belly. When a horse is overfed, or stimulated with strong hot food, he is liable first to become suddenly fat, next to have overrich or greasy secretions in the alimentary ducts, next to suffer relaxation and weakness in these organs, and next to acquire squeamishness and intestinal worms; and he, in consequence, comes to have eminent need of purging, proper exercise, and a clean diet.

When a young horse has a fiery temperament, and suffers enfeeblement of appetite from fretting

and devilment, he ought to have always a cool diet, and to be allowed ample scope for sobering himself by free exercise and exuberant frolics in the field. "Let these sort of horses run abroad," says Gibson, "especially where they have stables and warm ranges, to keep them from the inclemency of the weather in winter; for they are always tender, being, for the most part, extremely thin-skinned, and their blood of a thin texture, and easily put in motion. For the same reason, the best way, in summer, is to bring them up in the day time, and only let them run abroad in the night, they being more hunted with the flies than any other, which keeps them continually upon the fret, and hinders them from thriving. When such horses live till they are full aged, their heat and fieriness often abate, so that they grow more useful; but while they are young, they are more subject to inward imposthumations than horses of a cooler temperament; and these often kill them suddenly, or bring them into lingering consumptive maladies, which in some measure may be prevented by the above method."

Voracity of appetite in its worst forms, is known to farmers and veterinary surgeons under the name of FOUL-FEEDING: see that article. But this disease, as it occurs in other domestic animals than the horse, is comparatively rare, and scarcely ever assumes any unpleasant appearance which may not be removed by slight alterations or the mere regulation of diet. But a remarkable instance is on record—and may probably be but a specimen of occasionally occurring instances—in which constitutional and incurable voracity in the cow was caused by malformation of the manyplies. Two cows were observed, throughout their lifetime, to eat always more food than other cows, and sometimes so much as double, or even treble, and yet never to become fatter than other cows, or to yield as good or as much milk; and, when they were slaughtered, the internal surface of the manyplies of the one displayed rugæ not so long as a man's finger, and that of the manyplies of the other displayed corrugations even less strongly remarked. The animals were thus so constituted that they could not more than half digest their food, so that they were compelled to eat double the normal quantity in order to obtain sufficient nourishment for their continuing in health.—*Gibson on the Diseases of Horses.*—*The Veterinarian.*—*The Society of Gentlemen's Complete Farmer.*

APPLE. See APPLE-TREE.

APPLE-BERRY, — botanically *Billardiera*. A small genus of evergreen, climbing, greenhouse plants, of the Pittosporum tribe. Two species from New South Wales grow to the height of respectively 8 and 12 feet; and two from Van Diemen's Land, to the height of 8 and 20 feet. The blue-berried tallest species grows rapidly, flowers abundantly, and produces a handsome show of fine blue berries; and all the species, but parti-

cularly this one, are very desirable climbers for a conservatory.

APPLE-BLIGHT. See *ANTHONOMUS* and *APHIS*.

APPLE-TREE, — botanically *Pyrus malus*. The most popular fruit-tree of the British Islands, producing blossoms of the rosaceous order, and fleshy, succulent, subacid, saccharine fruits which form the type of the pomaceous group. In its wild state it is the common crab-tree, grows in the woods of Britain, attains a height of twenty feet, blossoms in the months of April and May, usually lives to a great age, and affords valuable timber for the turner, the mill-wright, and the cabinet-maker. In its cultivated state, it has sported itself and been artificially hybridized into such a profusion of varieties as almost defies minute enumeration; and at the same time has so totally relinquished its indigenous character, and so thoroughly combined itself with two or three other natural species, as to have become a perfect puzzle to any ordinary botanist. Even the most natural or least changed varieties of the apple, though botanically identical with the crab, can never be obtained from the latter's pips or pomes, and many of the most hybrid varieties may easily be seen to possess a considerably remoter botanical relationship to the crab than to some other natural species. Botanists usually enumerate six natural species of the apple kind,—*Pyrus malus*, or the crab-tree of Britain; *Pyrus spectabilis*, or the apple-tree of China, introduced to Britain in 1780; *Pyrus prunifolia*, or the crab-tree of Siberia, introduced in 1758; *Pyrus coronaria*, or the sweet-scented crab, a native of Virginia, and introduced to Britain in 1724; *Pyrus baccata*, or the small-fruited crab-tree, a native of Siberia, and introduced in 1784; and *Pyrus angustifolia*, or the narrow-leaved crab-tree, a native of North America, and introduced in 1750. The three last of these species, however, are rather ornamental plants than fruit-trees; the small-fruited species attains the height of 15 feet; and all the other species 20 feet; the British crab-tree bears white blossoms, and all the other species bear pink blossoms. The Siberian crab and its varieties produce much more brilliant blossoms, and have a much more handsome outline, than the strictly fruit-tree species.

Cultivators, whether nurserymen or gardeners, usually resolve all existing varieties of apple-tree into the British crab, the wild crab of Virginia, the dwarf or paradise apple, and the fig-apple.—The British crab exhibits three varieties,—one bearing wholly whitish fruit, another bearing fruit which is purple toward the sun, and the third having variegated leaves; but the varieties are not permanent, or are easily altered by cultivation or special treatment. The crab-tree is very hardy and of long duration; and it has admirable properties as a stock for grafting fine varieties of apple-tree upon,—continuing long sound, not running into luxuriant growth, and

maintaining the fruit of the engrafted varieties in their genuine size, colour, and flavour. But multitudes of cultivators, in order to save themselves a little trouble, do not raise true crab-stocks, but raise free stocks from indiscriminate sowings of the pips of all sorts of cyder apples, and designate as crab-trees all kinds of apple-plants which have been produced from pips, and not been grafted.—The wild crab-tree of Virginia grows indigenously in most parts of America, and is used by the natives as a stock for the grafting of fine varieties of apple; but in Great Britain it is somewhat tender while young, requires a rather warm situation, and is often propagated by budding or grafting upon the British crab. Its leaves are longer and narrower than those of other species, and are cut into acute angles on their sides; and its flowers, though not remarkable for fragrance in Great Britain, are delightfully odoriferous in America, and sometimes diffuse their perfume throughout entire woods.—The dwarf or paradise apple-plant is rather a shrub than a tree; and has scarcely sufficient strength to support its branches. Yet, though always of comparatively short duration, it is much used as a grafting stock for dwarfish and shrubby plants of fine varieties of apple; and, when so used, it bears sooner, occupies less space, and is fitter for the border of gardens than any crab stock. A permanent variety of the dwarf called by British gardeners the Dutch paradise apple-tree, and by the French gardeners Doucin, is much more suitable as a grafting-stock, does not so readily decay, or canker, or stint the grafts, and, when used for an espalier or a standard dwarf, attains a desirable size, and is easily kept within requisite limits. This variety, unhappily, has been for some time neglected, and is at present degenerating to canker and old age; but it may easily be renewed from seed, with full retention of all its former good qualities, and possibly with the acquisition of new.—The fig apple-tree is common to England and North America; and, though producing an inferior kind of fruit, is in considerable esteem with the curious and with persons of unusual taste. Its flowers are destitute of petals, yet contain the stamina and the other organs requisite to fructification, and are as regularly followed by fruit as if they were quite perfect in structure.

Twenty-two varieties of apple-tree were known to the Romans; and upwards of four hundred varieties are at present cultivated in Great Britain. Most of the varieties are deformed-looking objects as standard trees, and grievously offend the eye when they grow in groups; yet even these, and especially the better-shaped species, are everywhere, but particularly in shrubberies, very ornamental when in blossom. Some of the most valuable varieties are old importations from France, some are recent importations from America, and some are results, either new or old, of British horticulture. All are divided, according

to the qualities of their fruit, into dessert, baking, and cyder apple-trees; the dessert apples being highly flavoured, the baking apples such as become mellow by baking or boiling, and the cyder apples such as are sour, bitterish, astringent, and usually of small size. Apples are classified also as pippins or seedlings, pearmaines or comparatively pear-shaped fruits, rennets or queens, specked fruits, calvilles or white-skinned fruits, russets or brown fruits, codlings or falling fruits, and burknets or such as grow readily from cuttings.

The best dessert varieties, for use at the respective seasons of the year, are, at the end of June, the Juneating; in July, the nonpareil, the Yorkshire greening, the Margaret, the scarlet Juneating, the Norfolk colman, and the summer pearmain; in August, the Kentish fill-basket and the Hawthornden; in September, the Kerton and Dalmahoy pipin, the early Margaret, the oslin, the Amptill pearmain, the colville, the Kent, and the seek-no-farther; in October, the orange pipin, Ribston pipin, the gray rennet, the spice apple, and the anise-seed; in November, Franklin's golden pipin, the Borsdorf pipin, the red russet, and the margil; in December, Gibb's pipin, the golden pipin, the golden rennet, the Canadian rennet, and the Nelson; in January, the Norfolk storing, Hubbard's Sykehouse, and the red Ingestrie; in February, Dredge's Queen Charlotte, the Alexander, Skenn's kernel, the college pipin, and the royal pearmain; in March, the hollow-eyed Cornwall rennet, and Hughe's new golden pipin; in April, the Cockle and Whitmore pipin, the golden russet, Piles's russet, and Wheeler's extreme; in May, Spencer's pipin, the stone pipin, the prickly seedling, the royal George, and Ward's; and, in June, Dredge's Jane, the oaken peg, the carnation, and the reinette Franche à Côtes. The best baking varieties are, in June, Baxter's pearmain, and the stoup codling; in July, the Norfolk beaufin, the Norfolk storing, and the French crab; in August, the white codling, the red Astracan, the red streaks, the Eve apple, the courtpendu, and several codlings; in October, Piles's russet, the Blenheim orange, the cat's head, and the marmalade pipin; in November, the Wormsley pipin, the golden Harvey, the queening, and the golden russet; in December, Cooper's russet, Gibb's scarlet perfume, the John apple, and the Mansfield; in January, the hall-door, the royal pearmain, the Dutch queening, and Aclan's russet; in February, the Bringswood pipin, the cockagee, and the box-apple; in March, the quince, the white colville, Lord Camden's rennet, and the winter pearmain; in April, Spencer's pipin, the golden nonpareil, and the Spaniard; and, in May, the Norfolk paradise, Loan's pearmain, and the English rennet. The best cyder varieties are, the Siberian pipin, the Grange pipin, the Foxley, the Harvey, the Alban, the hogshhead, Stread's kernel,

the large stire, the Brunton seedling, the Hagloe woodcock, the yellow Siberian, the Dounton pip-pin, the Spring-grove codling, the Hawthornden codling, the golden Harvey, the white court-pendu, the Warwickshire pip-pin, Harvey's russets, the Bovey, the cockagee, the Dutch queen-ing, the John, the new red must, the old red must, the Pewsan queening, and the red streak.

The varieties best fitted for the orchard, being strong and hardy in growth, and sure bearers, are the cockpit, the Dounton pip-pin, the Duchess of Oldenburgh, the Dutch codlin, Franklin's golden pip-pin, the gloria mundi, the Hawthornden, the Kerry pip-pin, the Keswick codling, the red quarrenden, the Salopian pip-pin, the Saint Julien, the striped Juneating, the striped monstrous rennet, the white colville, the Wormsley pip-pin, the beauty of Kent, the Bedfordshire foundling, the Blenheim orange, the cockle pip-pin, the Courtwick, Cowarne's queening, the Doeping, the Duke of Wellington, the Dutch mignonne, Fearn's pip-pin, the flower of Kent, the French crab, the French russet, the golden russet, the green nonpareil, the Hanwell souring, the king of pippins, Kirke's Lord Nelson, the large russet, the incomparable crab, the Kentish broading, the Kentish fill-basket, the Kentish pip-pin, the lemon pip-pin, Lewis' incomparable, the London pip-pin, Lucombe's seedling, the marmalade pip-pin, the Minshal crab, the Newtown pip-pin, the nonpareil russet, the Norfolk beaufin, the northern rennet, the pound apple, the Ribston pip-pin, the rymer, the seek-no-farther, the striped Holland pip-pin, and the Yorkshire green-ing. The best varieties for grafting on paradise stocks are the beauty of Kent, the Borsdoffer, the Bringswood pip-pin, Christie's pip-pin, the cockle pip-pin, the Cole apple, the Courtwick, the Delaware, the Duchess of Oldenburgh, the Dutch mignonne, the Emperor Alexander, Fearn's pip-pin, the golden pearmain, several golden pippins, the Grange, the Gravenstein, the Herefordshire pearmain, the Hollandbury, the Isle of Wight pip-pin, the Kerry pip-pin, the Kilkenny codling, the Kilkenny astems, the King of the pippins, Kirke's golden rennet, the margil, several nonpareils, the Norfolk pip-pin, Padley's royal George, the pomme grise, the red Astracan, the red In-gestrie, the reinette grise, the Ribston pip-pin, the Sykehouse russet, and the Wyken pip-pin. The best varieties for growing on walls of either southern, eastern, or western aspect, generally ripening well, and always of exquisite flavour when newly gathered, are the American fall, the Beauchamp-well seedling, the Bringswood pip-pin, Christie's pip-pin, the Cole apple, the Courtwick, the Delaware, Fearn's pip-pin, the golden pearmain, several golden pippins, the Isle of Wight pip-pin, the king of the pippins, Kirke's golden rennet, the Male carle, the margil, the Newtown pip-pin, several nonpareils, the Wyken pip-pin, the Syke-house russet, Padley's royal George, the pomme

grise, the red Ingestrie, the reinette grise, and Ribston's pip-pin.

These lists of mere names are necessarily somewhat vague, they unavoidably contain repetitions of the same varieties, and they are rendered additionally inexplicit by considerable ambiguity or unsettledness in the prevailing market nomenclature of fruit. We would gladly both illustrate and extend them by brief descriptive notices of all the varieties, but are compelled by due care for the symmetry of our work to restrict ourselves to brief notices of only a very few.—The early Margaret or scarlet Eve apple is a middle-sized fruit; its shape oval, but flattened at the ends; its eye shallow and wrinkled; its stalk short, and inserted in a shallow cavity; its sides slightly angular; its colour, when ripe, a yellowish green, with some russet brown about the stalk, and a bright crimson marked with darker streaks toward the sun; its flesh whitish, but sometimes tinted with red next the skin, crisp and juicy; and its flavour saccharine, pleasantly acidulated, and exhaling a rich aromatic fragrance. The tree is middle-sized, grows erect, and bears well.—The oslin apple is a middle-sized, roundish, oblate fruit; its eye wide and shallow; its calyx often prominent and a little wrinkled; its stalk short, and inserted in a wide and shallow cavity; its sides sometimes slightly angular; its colour, when ripe, a bright yellow, speckled with russet, and clouded about the stalk; its flesh yellowish, crisp, and juicy; and its flavour delicate, saccharine, and aromatic. The tree is dwarfish, makes erect shoots of a light gray colour, has light green leaves, and is an abundant bearer.—The red Astracan apple is above the middle-size; its shape roundish, but a little flattened at the ends; its sides irregular; its eye broad and deep, but closed by the calyx, and uneven on the edge; its stalk short, and deeply sunk in an angular cavity; its colour yellowish, mixed with light red to the shade, and a deep cherry red covered with a purplish bloom to the sun; and its flesh very white, tinted with red next the skin, firm, juicy, and well-flavoured. The tree is strong, erect, and a good bearer.—The Kerry pip-pin is about the middle-size; its sides smooth, sometimes warted, and often nipped at the stalk; its eye broad, shallow, and wrinkled; its colour a bright yellow, piped all over, and slightly tinted with red toward the sun; its flesh yellow, crisp, and juicy; and its flavour saccharine and delicate. The tree is vigorous, makes downy, spurred, erect shoots, and is an excellent bearer.—The spice apple, or aromatic russet, is a middle-sized fruit; its shape conical; its sides obtusely angular; its eye wide, shallow, and much ribbed; its stalk long, slender, and set in a deep cavity; its colour a greenish yellow in the shade, and a dull red or cinnamon to the sun, with interspersions of much russet throughout; its flesh white, soft, and juicy; and its flavour rich, saccharine, and highly aromatic. The tree thrives in every situa-

tion, makes slender declining shoots, and seldom fails to yield a good crop.—The white russet is of large size; its shape irregular, but approaching to oblate rotund; its sides unequal and obtusely angular; its eye large and furrowed; its stalk short, and inserted in a large cavity; its colour greenish yellow, clouded with russet and white to the shade, and often delicately tinted with a light blush to the sun; its flesh pale yellow, soft, and mellow; and its flavour saccharine and rich. The tree grows erect, makes strong light-gray shoots, and has pale green leaves; and, though rather a thin bearer, compensates for the fewness of its fruit by their size and richness.—The scarlet queening is about the middle size; its shape conical; its sides irregular; its eye small, deep, and wrinkled; its stalk long, and set in a deep cavity; its colour yellow, blotched, and streaked with red; its flesh firm and juicy; and its flavour saccharine and aromatic. The tree is a good bearer.—The margil is of middle size; its shape conical; its sides slightly angular; its eye small and wrinkled; its stalk slender and deeply set; its colour a bright yellow, striped and clouded with red toward the sun, and shading into russet around the stalk and the eye; its flesh yellowish, firm, and juicy; and its flavour saccharine, vinous, and piquant. The tree is vigorous, sends out delicate, diverging, and very downy and spurred shoots, has small lanceolate leaves on long foot-stalks, and is a good bearer.—The courtwick pippin is below the middle size; its shape oval, with flattened head; its sides smooth and sometimes warted; its eye large, shallow, sunk, and a little indented; its stalk short, set in a wide cavity, and often oblique; its colour yellow, mixed with russet, and ruddy to the sun; its flesh richly yellow, crisp, and juicy; and its flavour saccharine and agreeably acidulated. The tree is strong, makes slender and erect shoots, and is an abundant bearer.—The Ross nonpareil is a middle-sized, roundish apple; its sides smooth, but sometimes warted; its eye shallow; its stalk about an inch in length, and deeply inserted; its colour yellowish, nearly covered with russet, and a deep red with darker stripes toward the sun; its flesh firm and whitish; and its flavour saccharine and fragrant. The tree is strong, makes slender shoots, has a spreading head, and is an abundant bearer.—The Ribston pippin is a large, oblate, rotund apple; its sides angular; its eye deeply furrowed, and closed by the calyx; its stalk short, deeply inserted, and sometimes elbowed; its colour yellow, blotched with russet, particularly at the eye and the stalk, and spotted and striped with bright red toward the sun; its flesh yellow, firm, and sometimes coarse; and its flavour saccharine and aromatic. It is very closely allied to the margil, yet scarcely equals that apple in flavour. The tree has a spreading growth, and sends out strong shoots with very downy extremities.—The Beauchampwell seedling is below the middle

size; its shape oval; its eye prominent, but placed in a shallow basin; its stalk short, and inserted in a deep but narrow cavity; its surface uniform; its colour yellowish green to the shade, and reddish, interspersed with darker spots to the sun; its flesh yellow, firm, and juicy; and its flavour saccharine and highly aromatic. It is an excellent apple even in bad seasons. The tree sends up erect, brownish, downy shoots, has small oblong leaves, on long and slender foot-stalks, and is an abundant bearer.—The green nonpareil is a middle-sized, roundish, oblate apple; its sides smooth; its eye shallow; its stalk slender, inserted in a wide and shallow cavity, and sometimes elbowed; its colour yellowish green, clouded with russet, marked with dark specks, and a dull red to the sun; its flesh crisp and juicy; and its flavour saccharine, aromatic, and piquant. The tree makes slender, erect shoots, with striated or furrowed extremities, has long oval leaves on long foot-stalks, and is a good bearer; but, when growing in old garden ground, is liable to canker.—The Sykehouse russet is below the middle size; its shape flattish; its eye wide; its stalk short, and inserted in a shallow cavity; its colour yellowish green, much clouded with russet, and of a dull red to the sun; its flesh yellowish and firm, but mellow; and its flavour saccharine and pleasantly acidulated. The tree has a spreading growth, makes gross shoots, and is very vigorous and a great bearer.—The prickly seedling is a small round fruit; its sides smooth; its stalk thick, inserted in a wide cavity, and sometimes nipped; its eye large and deep; its colour bright yellow, but russet around the stalk, and a bright red toward the sun; its flesh yellow, juicy, and mellow; and its flavour saccharine and rich. The tree is vigorous, has an erect growth, and is a great bearer.—The reinette Franche à Côtes is a large oblong apple; its sides obtusely angular; its eye deep, very wide, and irregularly furrowed; its stalk long, slender, and deeply inserted; its colour green till quite ripe, and then yellowish, with some light reddish stripes to the sun, and specked with russet around the eye and the stalk; its form, when perfectly ripe, a little shrivelled; its flesh yellowish, juicy, firm, and mellow; and its flavour saccharine and rich. The tree has an erect and very strong growth, makes greenish-coloured shoots with a silky pubescence at their extremities, has oblong oval leaves, with remarkably parallel sides, and is an abundant bearer.

About twenty varieties were in prime repute nearly a century ago; and, though not all included in the lists which we have given, most continue to enjoy a large portion, and many continue to enjoy the whole, of their ancient reputation. Varieties of such thoroughly established, long tried, and universally admitted excellence, are eminently valuable, and deserve a brief descriptive notice.—The white or French rennet is

a large, fine fruit; its shape roundish; its colour a pale green, becoming a little yellowish when ripe, and having some small gray spots; and its flesh saccharine and juicy.—The rennette grise is a middle-sized fruit; its shape like that of the golden rennet; its colour a deep gray to the sun, intermixed with yellow to the shade; its flesh very juicy; and its flavour piquant.—The violet apple or pomme violette is a rather large fruit; its colour a pale green, striped with deep red to the sun; and its flavour saccharine and with a fragrance like that of sweet violets.—The court-pendu is a very large apple; its shape oblong; its sides marked, from base to crown, with irregular risings or angles; its colour pale to the shade, and red to the sun; its foot-stalk long and slender, and its habit of growth uniformly pendulous, so as to have procured for it from the French gardeners its name of court-pendu.—The original codling and the original golden rennet are everywhere known, and have been superlatively popularized by the several subvarieties of them which are in so general esteem.—The Margaret apple is a middle-sized fruit, and not so long as the original codling; its colour a pale green to the shade, and a faint red to the sun; its flesh firm; and its flavour pleasantly piquant.—The Kentish fill-basket is a kind of codling, but larger in size and somewhat more elongated in shape than the normal codling.—Loan's pearmain is a beautiful, middle-sized fruit; its colour a beautiful red toward the sun, and a striping with red to the shade; and its flesh has a vinous flavour, but soon becomes mellow.—The quina apple is a small fruit, seldom larger than the golden pippin; its shape like that of the quina, especially toward the stalk; its colour russet toward the sun, and yellowish toward the shade.—The aromatic pippin is about the size of a nonpareil, but a little longer; its colour a bright russet toward the sun; its flesh breaking; and its flavour aromatic.—The Hertfordshire or winter pearmain is a good-sized fruit; its shape rather long than round; its colour a fine red toward the sun, and a striping with red toward the shade; and its flesh juicy and acidulated.—The Kentish pippin is a large and handsome fruit; its shape oblong; its colour pale green; its flesh breaking and juicy; and its flavour sharply acidulous.—The Holland pippin is larger than the Kentish pippin; its shape more elongated; its colour a darker green; and its flesh firm and juicy.—The monstrous rennet is a very large apple; its shape oblong; its colour red to the sun, and dark green to the shade; and its flesh liable to be very mellow.—The royal russet or leather-coat russet is a large fair fruit; its shape oblong, but broad toward the base; its colour russet like that of leather; and its flesh yellowish. The tree is tall, well-shaped, and an abundant bearer.—Wheeler's russet is a middle-sized fruit; its shape round but flattened; its stalk slender; its colour a pale yellow to the shade, and a light russet to the sun; its flesh

firm and juicy; and its flavour very sharply acidulous.—Pile's russet is not so large as Wheeler's russet; its shape oval; its colour a dark green to the shade, and a russet to the sun; its flesh very firm; and its flavour very sharply acidulous.—The nonpareil and the golden pippin, like the original codling and the golden rennet, are everywhere known and universally approved, through the medium of their subvarieties.—The haute-bonne used formerly to be often sold in the English markets for the nonpareil; but it is a larger fruit than the latter, more inclining to yellow, brighter in the hue of its russet, not so flat in shape, not so acidulous in flavour, earlier ripe, and sooner gone.

North America has, for a considerable period, been celebrated for the great number and the surpassing richness of its varieties of apple-tree; it could probably produce, from even its ill-cultivated and almost natural orchards, a greater number of thoroughly good varieties than are at present known in Great Britain; it is admitted all over Europe to excel the old world in the aggregate excellence of both its apples and its peaches; and it has been regarded by some European phytologists as "a grand laboratory of nature for the production of new ameliorated fruits," or as possessing, in its soil or its climate or the joint influence of both, the power of progressively improving any variety of apple-tree through successive generations till it eventually attains a high degree of excellence. But while the fact of great wealth in the quality and number of North American varieties of the apple-tree is certain, the principles on which most phytologists have hitherto attempted to account for it are unsupported by observation and not very consistent with sound philosophy. All or very nearly all the kinds originally cultivated by the North American colonists were imported from Europe; some of the kinds most extensively cultivated and most highly approved at the present day were originally European; and, in particular, the Spitzemberg apple of New York and the Baldwin of Massachusetts, which are held in very great esteem, and have been extensively sent to Europe, were, in all probability, seedlings of the first generation from good imported European varieties. Almost all the good apples of English America, from the earliest date of English possession, down to a considerable period after the date of American independence, grew upon seedling-trees, raised from the pips or pomes of European varieties; and a large proportion of them upon seedling-trees of merely the first generation. The mode of propagation by budding and grafting was not known by peasants, farmers, and ordinary gardeners and orchardists; the establishment of nurseries, even in the sea-board districts of the New England states, was for a long time unthought of; and, so late as at the commencement of the present century, three-fourths of all the fruit-bearing apple-trees in the United States

were seedlings. Yet the rate of increase in the number of individual trees was wonderfully great; so much so that for every seedling-tree which bore fruit in the year 1600, no fewer than one hundred bore fruit in the year 1700, and at least one thousand in the year 1800. So enormous was the proportion of orchard-ground previous to the establishment of nurseries, that, on the average, every farm of 100 acres had from 6 to 10 acres under fruit trees; and as no market existed for the orchard produce, every farmer easily found, amongst his great number of seedling-trees, more than a sufficient number of good ones to supply apples to his family, and indiscriminately assigned the vast remainder for the use of his hogs. Thus, seedlings of the first generation, all the way along from the first colonizing of America till the present day, have been good, or at least have been similar in character to the parent plants; seedlings of successive generations upon the same spot, must, in consequence of the occupancy of the ground, have been comparatively few in number, and scarcely ever sown or aided by man; and improved varieties, whenever any appeared, were not propagated by budding and grafting, and could never have existed beyond the limits of a single tree except by propagation as seedlings of the first generation. The many rich new varieties which have appeared in North America, therefore, are no such ameliorations by successive generation as the theories of European phytologists have supposed, but must be traced to the operation of a cause at once simple, obvious, profoundly philosophical, and in exquisite harmony with the general physical laws of the Divine providence.

This cause is the intermixture of the pollen of different varieties. Experimental florists, simply by the intermixture of pollen, can, at pleasure, vary the shade of a lily or the fragrance of a rhododendron, and have produced many thousands of new varieties of violets, fuschias, dahlias, and other select flowering plants, and perfectly astonishing ameliorations of the best varieties formerly known; and general cultivators of plants, whether farmers, gardeners, nurserymen, or practical phytologists, have, simply by the intermixture of pollen, effected wonderful and very numerous improvements, as well as produced multitudinous new varieties, in many of the most useful culinary and agricultural plants. Nor is the apple-tree an exception to the power of intermixed pollen, but very strikingly the reverse. "Take a fruit tree of medium excellence; average the opinions of the 'Pomological and Gardener's Magazine,' and call the Hawthornden of Scotland such. Plant it beyond the reach of foreign pollen, and, I apprehend, its seedling offspring will not vary greatly from the parent standard; some of the seedlings will produce better and some worse fruit. If those seedlings are planted so that their pollen intermix, the second generation will exhibit signs of further departure in im-

provement and deterioration; and this variation will be greater as the soil, climate, and culture are varied; so that, in many generations, if the pollen be not permitted to mix, and the climate and culture remain the same, the departure from the parent standard of goodness will be trifling; but, on the contrary, if the pollen be indiscriminately mixed, and the climate and culture varied, the departure will be great." Either such improving or such deteriorating departure from the original as produces an entirely new and widely different variety is thus effected, mainly by the intermixture of pollen, though partly by alterations of soil, climate, and culture, in the course of a few generations from any one apple plant; and precisely the same result is effected, solely by the intermixture of pollen, in a single generation between almost any two very different kinds of apple plants; not only so, but, in consequence of the mere intermixture of pollen from neighbouring blossoms, existing trees, without any generation whatever, will sometimes become modified in their character and very sensibly altered in their fruit,—for example, a tree which produces green apples may, by growing immediately adjacent to a tree which produces yellow apples, acquire the property of producing yellowish-green apples or even absolutely yellow apples. Now let the enormous numbers of North American apple-trees be glanced at, their original European varieties, their indiscriminate intermixture, their great groupings in orchards, and their increase one-thousandfold in the course of two centuries; and, by simply adverting to the power of intermixed pollen, we instantly understand how the new varieties of North American apple-tree are so numerous, so strongly marked, and so exquisitely rich.

When apple-tree plants are raised from seeds, whether the kinds for grafting upon or kinds intended to bear as seedlings, the pips or the pomes ought to be sown on dry ground in November or December, on wet ground in February. Almost all cultivators use the mere pips as seed, and even take care to clear them thoroughly from the pulp; and many in the south of England, when the plants to be raised are grafting sticks, sow pips which remain after pressing sour apples for verjuice or cyder. But a decidedly more natural method, and one which cannot fail to educe a superior average healthiness and vigour in the plants, is either to sow the entire pomes, or to sow the pips in mould which has been well-manured with decayed apples. The flesh which surrounds the pips in all apples is clearly designed by the Creator to serve as the pabulum of the future tree; and its sugar, its malic acid, and its other constituent elements almost certainly bear to each other, in every variety of the plant, the exact proportion which will operate most beneficially on both the soil and the plumule. To withhold the fleshy matter of the pomes, therefore, or even to substitute it with very carefully prepared

manure, is seriously to interfere with the natural economy of the apple's vegetation, and must, to some extent, however imperceptibly, damage the constitution of the future plants.

When pips are designed to be used as seed, and are obtained from the cyder manufactory or otherwise abstracted from the pomes, they ought to be preserved in dry sand, and kept out of the reach of rats and mice; and even after being sown, they ought to be protected from these vermin by means of traps. The pips may be sown upon a bed of light earth, and covered to the depth of about half an inch. In spring, when the plants begin to appear, they must be carefully weeded; and if the season should prove to be dry, they ought to be watered twice or thrice a-week. During summer, they must be constantly kept clear of weeds. In the following October, if the plants have been healthy, they may be transplanted into clean, well-pulverized nursery-ground, set at the distance of one foot from plant to plant, in rows three feet asunder, and adjusted somewhat firmly in their places, by lateral pressures of the soil. Stocks thus early transplanted do not require to be headed; yet when they incline to shoot downward, they must have their tap root shortened, in order that they may be induced to send out horizontal roots. If the soil is good, and kept clean from weeds, the stocks intended for dwarfs, may be grafted in the second spring after transplantation; yet those intended for standards must not be grafted till the fourth spring, when they will be upwards of six feet in height.

"A difference of opinion," says Mr. Knight, "appears always to have prevailed respecting the quality of the soil proper for a nursery: some have preferred a very poor, and others a very rich soil; and both perhaps are almost equally wrong. The advocates for a poor soil appear to me to have been misled by transferring the feelings of animals to plants, and inferring that a change from want to abundance must be agreeable and beneficial to both. But plants in a very poor soil become stunted and unhealthy, and do not readily acquire habits of vigorous growth, when removed from it. In a soil which has been highly manured, the growth of young apple-trees is extremely rapid; and their appearance, during two or three years, generally indicates the utmost exuberance of health and vigour. These are, however, usually the forerunners of disease, and the 'canker's desolating tooth' blasts the hopes of the planter. I have seen many instances, in the black rich mould of an old garden, where young trees of the native crab could scarcely preserve their existence; and such mould appears almost equally fatal to the peach and nectarine trees. It has justly been remarked by Evelyn, that annual plants, having only a short time in which they are to fulfil the intentions of nature, readily accept any assistance from manure, and are rarely injured by the excess of it: but that

trees, being formed for periods of long duration, are injured when attempts are made to accelerate their early growth by the stimulus of a large quantity of nutriment. In choosing the situation for a nursery, too much shelter, or exposure, should be equally avoided; and a soil, nearly similar to that in which the trees are afterwards to grow, should be selected, where it can be obtained. Pasture ground, or unmanured meadow, should be preferred to old tillage, and a loam of moderate strength, and of considerable depth, to all other soils."

The well-known variety called the Arbroath oslin or original apple, and all the burknot and codling tribes, grow freely from cuttings, and may be propagated almost as easily as poplars or willows. A new method of propagation has, within the last ten or fifteen years, been repeatedly stated in public journals to have been invented and successfully practised in Bohemia,—to insert apple-tree shoots or cuttings in potatoes, and plunge them into the ground, leaving only an inch or two inches of the cutting above the surfaces; but this method has been fairly tried by experimentalists in Scotland, and found to be utterly inefficient. The general, indeed almost universal mode of propagation in Great Britain is by grafting or budding fine varieties upon the stocks of coarse, hardy, vigorous, straight growing varieties; this method is facile, adapts itself to every form and size of required tree, and is applicable and efficient in the case of every kind of apple-tree; and, even in America, where the seedling system was so long universally prevalent, this engrafting method is now in general use, nurseries being everywhere established, and hardly any but the finest engrafted young trees being any longer in requisition. All stocks raised from the seed of crab-trees or of cyder varieties of apple-trees are technically called *free stocks*, and are employed for all orchard standards and for lofty espaliers. The stocks of the paradise species, as we formerly saw, are employed for dwarf standards, for low espaliers, for the borders of gardens, and for low trees in any situation which are wished to bear fruit in comparatively early age, at the expense of becoming correspondingly soon exhausted. "Some," says Miller, "have made use of codling stocks for grafting apples, in order to stint their growth; but as these are commonly propagated by suckers, I would by no means advise the use of them, nor would I choose to raise the codling trees from suckers; but rather graft them upon crab stocks, which will cause the fruit to be firmer, last longer, and have a sharper flavour; and these trees will last much longer sound, and never put out suckers, as the codlings always do, which, if not constantly taken off, will weaken the trees, and cause them to canker; and it is not only from the roots, but from the knots of their stems, there are generally a great number of strong shoots produced, which fill the trees with useless shoots, and render

them unsightly, and the fruit small and crumpled."

The average distance from one another at which apple-trees upon crab-stocks ought to be planted for espaliers, is 20 feet for the smallest growing kinds, 30 feet for the middle-sized kinds, and 40 feet for the largest growing kinds. Examples of the smallest growing kinds, among the long-established and generally known varieties, are the quina-apple, the golden pippin, and the pomme d'api; of the middle-sized kinds, the Margaret, the golden rennet, the aromatic pippin, the rennette grise, the white rennette, and most codlings; and of the largest growing kinds, the Kentish pippin, the Holland pippin, the monstrous rennet, the royal russet, Wheeler's russet, Pile's russet, the nonpareil, the violet apple, and all the pearmains. Persons who have not observed the vigorous growth of apple-trees, will think twenty feet for the smallest-growing varieties, and forty feet for the largest-growing varieties, too great distances, and will suppose that the trees can never so extend their branches toward one another as to cover the espalier; but if they will mark how widely standard-trees extend their branches on all sides, and will remember that espalier trees have to effect their lateral growth on only two sides, they will soon be convinced that the distances are sufficiently close. For the sake of both symmetry and economy, only trees of equal or very nearly equal habits of growth as to size, ought to be grown upon any one espalier. Dwarf cherry-trees, currant-bushes, or other small fruiting plants may be planted between the apple-trees, to bear for a few years, and to be cut away when the trees are ready to occupy most of the space. When young apple-trees are selected for planting, those of one year's growth from the graft ought to be preferred, and all of greater age than two years' growth from the graft rejected; the stocks should be sound, smooth, and free from canker; the small fibres of the roots ought to be entirely cut away, in order to prevent mouldiness in the ground, or any obstruction to the growth of new fibres; and the extremities of the roots ought to be shortened, all bruised parts of the roots cut off, and all misplaced roots which cross each other cut away. The best season for planting is from October to the middle or end of November, or either immediately or very soon after the fall of the leaf, in open and comparatively mild weather. A stake should be placed to each tree for the fastening of any precocious shoots; some tanner's bark, rotten dung, or other protective covering matter should be placed about the roots, in the event of the winter being severe; and two or three stakes should be placed to each tree, before it begins to push in spring, to give the branches a horizontal fastening, and to effect for the tree a thorough establishing in its new quarters. In subsequent management, the knife ought to be very sparingly used, and, except when there is an

absolute want of shoots to fill the spaces of the espalier, it ought never to be applied for the shortening of the branches; for when it is much used, it only multiplies useless shoots, and prevents branches from fruiting. The best method is to examine the trees three or four times during the growing season, to rub off all such shoots as are irregularly produced, and to train the others to the stake in their permanent position. The shoots, if gently bent from time to time as they are produced, will easily take the direction and place assigned to them, without the use of force or any risk of fracture. The cursors or spurs are the fruiting parts on all apple-trees, and will continue fruitful during many years, so that they ought never to be cut off. "Each variety of the apple-tree," says Mr. Knight, "has its own peculiar form of growth; and this it will ultimately assume, in a considerable degree, in defiance of the art of the pruner. Something may nevertheless be done to correct whatever is defective. When the growth of any variety is weak and reclining, the principal stem should be trained to a considerable height, before it be allowed to produce branches; and if any of these take an horizontal or pendant direction, they should be regularly taken off. One principal leading stem should be encouraged almost to the summit of the tree, to prevent a sudden division into two large boughs, of nearly equal strength; for the fork which these form is apt to divide and break when the branches are loaded with fruit. All efforts to give the heads of young trees a round and regularly spreading form, whilst in the nursery, will be found injurious in the future stages of their growth. Large branches should rarely or never be amputated. In the garden-culture of the apple, where the trees are retained as dwarfs or espaliers, the more vigorously growing kinds are often rendered unproductive by the excessive, though necessary, use of the pruning-knife. I have always succeeded in making trees of this kind fruitful by digging them up, and replacing them with some fresh mould in the same situation. The too great luxuriance of growth is checked, and a disposition to bear is in consequence brought on."

Apple-trees for standards require, on the whole, to be transplanted and managed very similarly to trees for espaliers; but young trees of two years from the graft should be preferred, and older ones not rejected; such branches as cross each other or are ill placed should be cut away; the transplanted trees should stand at the distance from one another of 50 or 60 feet in good soil, and 40 feet in inferior soil; stakes should be placed and fastenings made for protection against the winds, the fastenings so adjusted with the aid of haybands or woollen cloth as to prevent the bark from being rubbed or bruised; strong fences should be maintained or erected for preventing the approach of cattle; the surrounding ground should be kept in a state of free

and clean tilth with the plough or the spade; no other pruning should be practised than the excision of branches which are broken or decayed, or of branches which cross one another, and which, if left, would rub and tear the bark; and any suckers or low-growing shoots which may from time to time make their appearance ought to be entirely dis severed from their stems.

The keeping of apples through the winter has provoked general attention, exercised much ingenuity, and educed a large amount of invention; and still it continues to be far from well or universally understood. Methods have been recommended of preserving them on the shelves of rooms inaccessible to frost; of burying them in the earth, in the same manner as potatoes; of placing them in layers or sheets, alternately with layers of straw or fern; of spreading them on the floor of a loft, out of contact with one another, and exposed to a free ventilation from the exterior air; of covering them with bran; of covering or immersing them with dried white sand; of shutting them up in warm closets; of maintaining them in the low, unfreezing, uniform temperature of a cellar; of constantly excluding them from the light, but permitting the access of the air; of subjecting them to preliminary sweating in heaps; of storing them immediately after being gathered; of very frequently, or so often as once a-week, examining them, wiping them, and removing all which show specks or other incipient symptoms of decay; of packing them in boxes or barrels with a thick covering of linen or other closely-textured cloth; and of wrapping them in paper, and packing them in close boxes. But, excepting the simple and easy conditions of keeping them dry, clean, and inaccessible to frost, all the really effective art of protecting apples from early decay consists in a careful gathering of them at the periods of their being ripe. The practice, so generally prevalent, of making what is called 'a clean sweep' of an orchard, or of clearing it at one gathering, is monstrously unphilosophical, and constitutes the true origin of probably three-fourths of all the tendencies of a crop to early decay. Judgment is exercised in other harvestings, and why not in this? One variety of pea ripens later than another, and is allowed a longer time by the cultivator to remain ungathered; one variety of wheat is not quite ready for the sickle, when another variety has been cut, dried, and housed; and one variety of potatoe retains its haulm green to a later period than another, and is allowed to remain correspondingly longer in the ground. But many varieties of apples usually grow together in one orchard; these varieties generally differ very widely from one another in their dates of complete ripeness; even apples of one variety, growing upon one tree, are not all ripe at one period; and, therefore, the apples of an orchard, far more than the pease of a garden or the grains and green crops of a farm, ought to

be gathered in a series of harvestings corresponding to their successive periods of ripening. Some kinds are quite ready for gathering very early in autumn; other kinds are usually not ready till the middle of December or even the early part of January; and the kinds which yield the great bulk of crop for preservation till spring, extend their periods of ripening through a range of several weeks. When the fruit begins to drop freely, but not a day earlier, the harvesting of an orchard ought to commence. The gatherers should have ladders of sufficient length to reach to the top of the trees, and shallow baskets for receiving the fruit, and conveying it to the fruit-room. Only the ripest fruits of each tree, or those which, when raised to the level of the footstalk, part freely from the tree, ought to be taken; and they should be laid gently in the baskets, one by one, till the baskets are full, and then conveyed to the barn or the fruit-room, and removed, one by one, from the baskets to the barn-floor or the fruit-room shelves. Only a process like this is wise and economical; and it ought to be repeated every third or fourth day till the whole crop of the orchard is gathered.

The fruit-room ought to be situated in the driest, coolest, and most shaded spot which comports with convenience, perfectly free from damp, suitable in size to the extent of the orchard, and provided with beech or plane-tree shelves, about two feet broad, and ten inches asunder. The apples must lie ten or twelve days in heaps on the barn-floor, or in sheets on the fruit-room shelves, to undergo the peculiar constitutional chemical action technically called sweating; and, during the whole of this period, if the weather be clear and dry, abundance of air must be admitted,—but if the weather be damp, the exterior air must be completely excluded. At the end of the ten or twelve days, the apples must be wiped one by one with clean soft cloths; all which are not perfectly sound must be removed, and those on the barn-floor may be packed in chests, barrels, or other suitable packages for final storing and for the market; while those in the fruit-room, after the shelves are wiped on both sides to perfect dryness, must be returned to the shelves. About the end of January the latter ought again to be turned over, and any which are damp, as well as both sides of the shelves, carefully wiped. From this time, the room, in order to prevent the fruit from becoming shrivelled, must be kept close, and the apples handled only with the utmost gentleness, and never except for the removal of damp from themselves or the shelves. During the remainder of the season, or till the end of summer, the apples must be lifted two or three times, and the shelves wiped to dryness; and, on every occasion, the fruit ought to be handled only with gloved or at least perfectly dry hands. On every fourth or fifth day, too, the shelves should be examined by the eye, that every decaying apple may be removed, and its place thoroughly wiped. A

curious account of the modes of keeping apples among the ancients may be seen in Owen's *Agricultural Pursuits*, or the 52d No. of the *Quarterly Journal of Agriculture*. See articles PYRUS, ORCHARD, ESPALIER, GRAFTING, MALIC ACID, APHIS, CYDER, and ANTHONOMUS.—*The Pomological Mag.*—*Ronald's Pyrus Malus Brentfordiensis*.—*Owen's Agricultural Pursuits*.—*The Quarterly Journal of Science*.—*London's Encyclopædia of Plants*.—*Miller's Gardener's Dictionary*.—*Marshall on Planting*.—*London's Encyclopædia of Gardening*.—*London's Gardener's Magazine*.—*Mawe's Gardener's Calendar*.—*Transactions of the London Horticultural Society*.—*The Quarterly Journal of Agriculture*.—*Memoirs of the Caledonian Horticultural Society*.—*Journal of the Royal Agricultural Society of England*.—*Treatise on the Culture of the Apple and Pear* by T. A. Knight.

APRICOT,—botanically *Armeniaca*. A genus of fruit-trees of the drupaceous tribe, bearing blossoms of the rosaceous family, and fruit closely allied to the cherry and the plum. The common species, *Armeniaca vulgaris*, formerly ranked with the plum-trees, and called *Prunus Armeniaca*, has been generally supposed to be a native of Armenia; but it is assigned by some geographical botanists to the whole of the Caucasian region, by others to the portion of Africa which lies north of the Niger and south of the Atlas, and by others to the north-western districts of China. It almost covers some of the Caucasian heights to their summit; it is a large, spreading, profusely branched tree in Japan; it has sported itself into many varieties, both single-flowered and double-flowered, and is extensively cultivated as an ornamental plant, in most known parts of the Chinese territories. It was known in Italy, under the name of *Præcocia*, in the time of Dioscorides; and it is supposed to have been introduced to Great Britain in 1524, by Wolfe, a French priest, and gardener to Henry VIII. Its English name is either a corruption of the Latin word *præcose*, denoting earliness of fruiting, or, more probably, a corruption of the names by which it is known in Tuscany and Arabia, and which seem, in their turn, to be corruptions of the ancient name *præcocia*.

The apricot tree, in its normal character, grows to the height of about fifteen feet, but, in its numerous varieties, and under diversified culture, varies in stature from a small undershrub to a tree of thirty feet in height. Some of the dwarfish and double-flowering varieties are highly ornamental, and may be cultivated in pots; some of the shrubby and the middle-sized varieties make a handsome figure in shrubberies and gardens; and even the tallest and best-fruited varieties may be so planted and managed as to contribute almost as much pleasure to the eye by their blossoms and foliage as enjoyment to the palate by their fruit. "This tree, as well as most sorts of fruit-trees," remarks Hanbury, "is exceeded by few in ornament; for, being permitted to grow in its natural state to twenty or thirty

feet high, with all its luxuriancy of branches, covered with their delightful heart-shaped leaves, what a glorious figure will it present! But when we reflect on the fine appearance such a tree must make early in the spring, when covered all over with the bloom of such fine flowers as those of the apricot are known to be, this enhances the value; and either of these motives is sufficient for introducing these trees into certain plantations. Add to this, some of the sorts, in warm well-sheltered situations, will produce fruit when growing in this manner, as well as if planted and trained against walls; so that additional returns will be made by the fruit to the curious planter of these trees."

The apricot, in a general view, is one of the earliest of our wall fruits, and next in esteem to the peach. The ripe fruit is second to no production of our gardens for jam or other preserves: it makes an exquisite liqueur, and gives a delicious flavour to ice; it excels all other garden fruits, in both beauty and agreeableness, for the purposes of pastry; and it possesses the recommendation, when used as a dessert, of being pleasantly astringent to the palate and somewhat strengthening to the stomach. But the over-ripe fruit is divested of a large proportion of its aroma and its other elements of delicious flavour, and is clammy, comparatively insipid, and not so easy of digestion; and the unripe fruit is acidulous and strongly astringent, yet forms an excellent material for a tart. The apricot, like the plum, may be gathered unripe, and placed in a dairy, an ice-house, or any other cool place, to undergo a slow ripening; and will thus become available as a dessert during two or three weeks longer than its natural period. It is a fruit, however, which agrees ill with the opposite process of forcing.

Thirty-nine varieties of apricot tree have been described in the Horticultural Society's Catalogue; about fifteen or twenty have been closely examined by scientific botanists; and about eight or ten have been recommended by the most practised horticulturists for general adoption into gentlemen's gardens. All these varieties are the offspring of *Armeniaca vulgaris*; and additional to them is the peach-apricot tree, producing a large fruit, and supposed to be a hybrid between the apricot and the peach. Yet three other species of *Armeniaca* have recently been introduced to Great Britain; the Siberian, *A. Siberica*, in 1788; the thick-fruited, *A. dasycarpa*, in 1800; and the Brigancou, *A. Brigantiaca*, in 1819. The varieties of the common apricot recommended for general adoption by the conductors of the Pomological Magazine are the hemskirke, usually ripe in the end of July; the royal, ripe in the end of August; the large early, ripe in the middle of July; the Breda, ripe in August; the Moorpark, also ripe in August; the Brussels, ripe in the beginning of August; the orange, ripe in August; and the Turkey, ripe

late in August. All these varieties, except the orange and the Brussels, are eminently suitable for dessert; the orange, the Brussels, the Breda, and the Moorpark, are eminently suitable for preserving; the trees of the Brussels and the Breda will grow as standards; and the trees of all the others require to be grown upon the wall. Mr. Lindley specially recommends all the same varieties as the Pomological Magazine, and adds the Roman, the red masculine, and the peach-apricot. The varieties which were in chief favour nearly a century ago, and which demand special notice on account of their long-established and well-tried celebrity, are the masculine, the orange, the Algier, the Roman, the Turkey, the Breda, and the Brussels.

The masculine apricot is small, roundish, red towards the sun, greenish yellow to the shade, and distinguished more for the earliness of its habit than for the excellence of its flavour. The blossoms of this variety are often profusely abundant; but in consequence of their appearing early in spring, they are exceedingly liable to be much thinned by chills or frosts.—The orange apricot is much larger than the masculine; and as it ripens, it changes to a deep yellow colour. But its flesh is dry and not highly flavoured, and serves better for tarts than for the table.—The Algier apricot has an oval shape, a little compressed on the sides; it turns, when ripening, into a pale yellow or straw colour; and its flesh, like that of the orange apricot, is dry and not highly flavoured. This variety has sometimes been confounded with the common or normal apricot.—The Roman apricot is larger than the Algier, not so compressed in the sides, deeper in colour, and not so dry in the flesh.—The Turkey apricot is larger than even the Roman, deeper in the colour, firmer in the flesh, higher in the flavour, and globular in shape.—The Breda apricot is a large roundish fruit, and changes to a deep yellow when ripe; its flesh is soft, very juicy, and interiorly of a deep orange colour; and its drupe is larger and rounder than that of any of the preceding varieties. This apricot was esteemed the best of all which were known in the time of Miller; and is eminently good when ripened on a standard.—The Brussels apricot is a middle-sized fruit, somewhat oval in shape, red with many dark spots toward the sun, greenish-yellow toward the shade, firm in the flesh, high in the flavour, and often cracks before it is ripe. This variety very nearly equals the Breda in excellence, and is sometimes preferred to it; but it requires to be ripened on a standard, and is always late and deteriorated when grown upon the wall.

All the varieties of the apricot tree are propagated by budding upon plum stocks; and, with one or two exceptions, in which some nicety of adaptation is required, they will grow freely upon free and thriving stocks of any varieties of the plum. All the wall kinds ought to be planted

against east and west walls, for if planted against a south one, they will produce mellowed and otherwise inferior fruit. The borders under the walls ought to be six or even eight feet wide, and not more than about two and a quarter feet deep. If the ground be a wet cold loam or clay, a bottom should be formed of stones or rubbish, and the borders raised above the level of the surface; and if the ground be chalk or gravel, the border ought to be wholly formed by the superposition of a sufficient depth of carried earth. The soil most suitable, either in these cases or in others of a less difficult or more natural character, is fresh or virgin earth from pasture land, cut ten inches deep, taken with the sward, laid out during twelve months to rot and mellow, and frequently turned and worked during that period, so that it may fully and minutely undergo the chemical action of the atmospheric air. This fresh and thoroughly prepared soil ought to be filled into the whole of the border two months before the time of planting the trees; and it should be raised to the height of four or five inches above the intended permanent level, in order that it may be settled to about that level when the trees are planted. If the soil be of proper temper—either dry, or at least not damp—the best time for planting is the month of October. The trees selected ought to be of one year's growth from budding; and they should be prepared in the same manner as peach trees, and deprived of all strong foreright shoots. The proper distance between each two trees, in good strong soil, or against a low wall, is twenty or twenty-two feet; and, in moderate soil, eighteen feet. Let the planter make a hole where each tree is to stand; let him place the stem about four inches from the wall, incline the top to the wall, and fix the tree in the ground; and then let him nail the branches to the wall, and cover the surface of the ground around the root with rotten dung. In the beginning of March, if the weather be good, or a little later if the weather be severe, let him cautiously unnailed the branches, and with a sharp knife cut off the head of the tree, and shorten each shoot to about four or five eyes above the bud. In spring, if the weather be dry, let him give the trees gentle waterings; and in summer, when the weather begins to be hot and droughty, let him place some sward or other similar cover around the roots to prevent them from being injuriously dried. During spring and summer, also, let him nail horizontally to the wall all new branches as they are produced, and let him cut away all foreright shoots. At Michaelmas, when the trees have done growing, let him unnailed the branches, and cut off so much of them that the vigorous ones shall be only eight or nine inches long, and the weaker ones not more than five or six. Miller, who gives this last instruction, says, "I suppose many people will wonder at this direction, especially having allowed such a distance between the

trees, believing the wall will never be filled by this management; but my reason for it is, that I would have no part of the wall left unfurnished with bearing wood, which must be the case if the branches are left to a greater length at first, for it seldom happens that more buds than two or three shoot for branches, and these are for the most part such as are at the extreme part of the last year's wood, so that all the lower part of the shoots become naked, nor will they ever after produce shoots; and this is the reason we see so many trees which have their bearing wood situated only in the extreme part of the tree." The shoots, when shortened, ought to be renailed in as horizontal a direction as possible. During the second summer, the cultivator ought to proceed almost as exactly as during the first; but let him never shorten any shoots in summer, or later in the season than April, except to furnish branches for filling vacant places on the wall; and let him, at Michaelmas, shorten the vigorous shoots to nine or ten inches, and the weaker ones to six or seven. The following year's management ought to be similar; but great care ought to be used, year by year, not to hurt or displace the spurs or cursons of the preceding year's growth, to shorten branches at the winter pruning in such a manner as to throw out fresh wood in every part of the tree, and to cut entirely away all luxuriant or supernumerary branches, or rather to displace them as soon as they are produced. Bearing branches, in any part of the tree, cannot be too strong, provided they are kindly; and supernumerary branches, when permitted to grow, effect an useless diminution of the vital energies of the plant. "I have often," says Miller, "seen trees brought to so weak a condition as to be able only faintly to blow their blossoms, and then most or all of the bearing branches have died, which has given occasion to the owner to imagine it was the effect of a blight, when, in reality, it was only for want of right management. I am fully persuaded half the blights we hear complained of proceed from nothing else but this." In the management of standard apricot trees, very little pruning is required; yet, early in autumn, or at the commencement of the genial period of spring, all dead wood, and all such branches as cross one another, ought to be removed. The apricot is liable to the attacks of wasps, large flies, and the same insects and diseases as the peach; and though it suffers less than the peach does, it will derive advantage from being sometimes protected with a net. See articles PRUNUS, PLUM, and PEACH.—*Lindley's Guide to the Orchard*.—*The Pomological Magazine*.—*Loudon's Encyc. of Plants*.—*Miller's Gardener's Dictionary*.—*Marshall on Planting*.

APRIL. See CALENDAR.

AQUARIUM. A series of artificial appliances for the garden growth of aquatic plants. It usually consists of an artificial pond, with compartments of various depths and adaptations,

and provision for slow and constant circulation of the water; and, in some recent instances, it comprises apparatus for heating by means of steam-pipes, in order to suit the habits of tropical aquatics.

AQUATIC PLANTS. Plants which grow wholly or partially in water. Some grow in the sea, some in rivers, some in lakes and ponds, some in ditches and fens, and others in marshes and meadows; some grow in a state of total immersion, some float on the surface of water, and others merely require a spouty, spongy, or bibulous soil; some have a configuration peculiarly adapted to their watery habitats, some have an organization adapted to amphibious life, or to alternations of immersion and droughty exposure, and others have a figure and constitution exactly similar to those of terrestrial plants, and, in some instances, are able to adapt themselves to comparatively dry situations.

The marine aquatics are by far the largest and most conspicuous class, and comprise the fuci, the ulvæ, and many of the conservæ. Some of the fuci, green as grass, have been brought up by the sounding-lead from a depth of upwards of 200 feet; one, *Laminaria pyrifera*, has been occasionally found of the enormous length of 850 feet; and several sometimes form floating marine meadows of great extent, and so dense as to entangle ships and obstruct their sailing. The last of these kinds, such as are found floating in masses on the surface of deep parts of the ocean, are supposed to have grown upon rocks at unfathomable depths, and to have been eventually swept away and sent to the surface by powerful under-currents. Other fuci,—well-known to the inhabitants of the British coasts under the names of sea-weed, sea-wreck, sea-thong, and sea-tangs, affording vast quantities of manure to sea-board farmers, and formerly burnt in vast heaps by the manufacturers of kelp,—attach themselves to stones and rocks on the borders of the sea and round the edges of bays and estuaries, and are, to a great extent, left uncovered to the air during the recess of the tides. From these fuci is obtained the iodine of the chemist and the pharmacist; and amongst them are the dulce and the laver, which many rough epicures of the lower classes are fond of eating.—The river aquatics comprise the chareaceæ, some of the ranunculaceæ and potamogetons, and many of the confervoidæ; and among the last are the oscillatoriae, which grow with singular rapidity, and make remarkable movements almost similar to those of the lower kinds of animated beings. The paludal or fen aquatics are in some instances wholly and in others partially immersed; they inhabit lakes and marshy or stagnant waters with clear or tolerably clear bottoms; and they comprise such plants as *Isoetes lacustris*, *Butomus umbellatus*, and many species and varieties of the ranunculus and white water-lily tribes.—The palustral and semi-terrestrial aquatics require

only spouty or very wet soil; and, in some instances, are capable of thriving on almost any ordinary ground; and they comprise some poplars, and numerous willows, grasses, and other plants of considerable economical value to the farmer.

Most aquatics are very curious in structure; and many of the larger herbaceous aquatics of the rivers, ponds, and marshes are eminently handsome in either their foliage or their flowers. Were they not provided with some special floating apparatus, they would not possess sufficient air in their leaves to be buoyant, and would sink and drown like animals; and nearly all, except the palustrine and semi-terrestrial kinds, are, in consequence, the subjects of some remarkable and beautiful contrivance for keeping them afloat. The genera *pontederia*, *trapa*, and *utricularia* exhibit a distension of the leaf stalk, so great as to have a swollen and gouty aspect; the genera *typha*, *sparganium*, *nymphaea*, and *sagittaria*, display myriads of air-chambers in the solid stem; the genus *jussieua* has its roots distended into vegetable swimming bladders; and the beautiful stove aquatic, *Limncharis Humboldtii*, possesses such an enlargement and air-expansion of the midriff of the leaf, that the leaf, though loaded with thrice the actual weight it has to carry could not possibly sink,—yet not all the midriff, but only the under side of it, and this in such adjustment to the adjoining flat or marginal portions, that the suffocation of the leaf by the upsetting of it, and the consequent placing of its upper or breathing surface in contact with the water, is effectually prevented.

Quick growing ligneous aquatics, such as several of the most common kinds of willows, may sometimes be very advantageously planted by a farmer. When gaps exist, or injuries occur in such fences as are situated in low, swampy, or boggy places, the best method of filling or repairing them is to plant truncheons of willow, alder, and similar aquatics along the gaps for hedge-stakes, and along the banks for subsequent plashing down; and this method possesses the additional recommendation of preparing a considerable future supply of fuel. In such places, also, and in waste spots which cannot easily be subjected to any better kind of improvement, the planting of longer truncheons for pollard trees will make very compensating returns. In low, spongy, boggy tracts near a stream, or in any other situation which combines the retention with the circulation of water, the planting of osiers and similar sorts of willows is probably as remunerating as any other business of a farm. See OSIER.

A considerable number of the grasses are either wholly aquatic in the paludal or palustral sense, or possess such constantly thirsty habits that they will flourish only upon decidedly moist soils; and they require, either as weeds or as cultivated plants, to be subdued or encouraged for the farm-

er's purposes, in a manner strictly adapted to their peculiarly aquatic nature. The most useful of these are *Alopecurus geniculatus*, *Festuca fluitans*, *Aira aquatica*, *Poa aquatica*, and *Agrostis stolonifera*. All these, except the last, if sown in mixture with other grasses, no matter how thickly, upon chalky, peaty, or very wet clayey lands, gradually and rapidly smother all the kinds sown with them, so as eventually to become solitary; yet they well deserve attention on most wet soils,—they may, by good management, be successfully sown among other grasses in the laying down of meadows,—and, whenever they truly thrive, they produce a great abundance of valuable fodder. The *Agrostis stolonifera longiflora* is so very peculiar and remarkable a grass, that the reader's special attention to it, through the medium of our articles AGROSTIS and FIORIN, will be well repaid. "The choice of these aquatic grasses must be regulated by the different degrees of moisture in the soil. On fens and morasses, if fiorin should not be chosen, perhaps there is none better, after a first drainage, than the water poa, which, by its spontaneous growth, will afford large crops, and at the same time allow the land time to settle. Such soils, however, consisting chiefly of decayed vegetable matter, require the aid of lime or some alkaline substance, to bring it into action; after which they may be brought, in the regular course of cultivation, to produce good permanent pasture. In situations not quite so wet, the flote fescue, flote foxtails, and rough-stalked poa may be added; and on land still better drained, the following mixture has been recommended,—four quarts of flote foxtail, two quarts of flote fescue, two pecks of rough-stalked poa, two pecks of meadow foxtail, two pecks of meadow fescue, and two quarts of vernal grass."—*The Botanical Register*.—*Keith's Botanical Lexicon*.—*Young's Farmer's Calendar*.—*Treatise on British Husbandry in Lib. of Useful Knowledge*.—*Loudon's Encyc. of Agriculture*.

AQUILARIA. See ALOE-TREE.

AQUILEGIA. See COLUMBINE.

ARABIS. See WALL CRESS.

ARABLE LAND. Land capable of being tilled with the plough. Arable land is very often, by an abuse of words, made to mean land in a state of actual tillage; and, in this sense, it is not only much more limited than in its proper one, but constantly shifts and varies in its application to any one district or farm, with the alternations of ley or grass and active courses of rotation. Arable land, in its true meaning, comprises, not only all ground in actual tilth whether by the plough or by the spade, but all gardens, lawns, and deep-soiled meadows in thoroughly cultivated countries, and all tracts of deep-soiled, open ground in the countries of the wild beast or the savage; and it is contrasted to woodland, mountain pasture, morass, sandy wilderness, rocky ground, and all other varieties of the earth's surface which are impracticable to the plough. Most of the arable

lands of the world have been formed by the agencies mentioned in our articles on ALLUVIUM, DILUVIUM, and DECOMPOSITION OF ROCKS; some have been laid bare or rendered available to man by the recession of the ocean and the bursting or draining of lakes; and a few have been formed by the decomposition of beds of pyrites, the eruptions of volcanoes, the overflowings of the sea, and various artificial processes of draining morasses, changing the texture of dry bogs, and mixing foreign and fertilizing ingredients with arid sands. The composition of the different kinds of arable lands will be pointed out in the article on SOILS; the distribution of arable lands in thoroughly cultivated countries will be noticed in the article on FARMS; and the methods of improving, cultivating, and managing arable lands will be detailed under the words DRAINING, PLOUGHING, ROTATION, MANURES, and in several other articles.—*Chaptal's Chymistry of Agriculture*.—*Liebig's Chemistry of Agriculture*.—*British Husbandry*.—*Rham's Dictionary of the Farm*.

ARACACHA,—botanically *Arracacia esculenta*. A perennial, herbaceous, tuberous-rooted plant, of the umbelliferous tribe. It has no beauty, but possesses remarkable utility in furnishing food for man, and might probably, by diffusion and judicious cultivation, become one of the most valuable plants in the world. It grows indigenously in New Granada and other parts of Columbia; it is there known under the name of Apio, and is considered the most useful and agreeable of all the plants, whose roots are used as human food; it has, for a considerable time past, attracted the attention of horticulturists both in Europe and the United States; it was, about fifteen years ago, introduced by some botanists and amateur cultivators into Great Britain; and it has been made the subject of many interesting experiments and observations at Montpellier, at Geneva, at Fromont, in the south of France, in the south of England, and in other places. It does not thrive in the hotter regions of South America, acquiring very small size of tubers, and expending its main strength in the production of stems; it thrives well in the districts whose mean heat is not greater than 60°, and best of all in the mountainous districts whose mean heat is between 55° and 60°; it is cultivated, with excellent result, in the Caraccas; it promises to adapt itself very readily to the climate of Italy, Spain, and the south of France; and though hitherto it has required the heat of the greenhouse in England, it has thriven in a sufficient number of instances in the open air, to warrant the hope that it may speedily be so acclimated as to flourish under field cultivation in the hop counties of England, and especially in all the southern and south-eastern counties of Ireland. We are not aware that any trials of it have been made in the counties of Cork, Wexford, or Kilkeuny; but we are sanguine as to the results whenever they shall be judiciously made; and

we would suggest that, in the present disastrous state of potato cultivation, trials of the aracacha should be made throughout all the south and the centre of both Ireland and England. A figure of this plant is given in *Plate XVII*.

The stems of the aracacha grow to the height of from two to four feet; the leaves are long and pinnated, and resemble those of celery; and the roots are large fleshy tubers, somewhat resembling, in their form and clustering, the tubers of the dahlia. The knobs or tubers of the root, however, are of two clusters and kinds: those produced from the upper part of the root are comparatively small in size, incline upwards, and individually produce several germs or shoots toward the tip; and those produced from the central and lower parts of the root, are larger than the former, descend into the soil, excel the root itself in tenderness and in the delicateness of their flour, and are the kind preferred for food and generally brought to table. Eight or ten of these large and chief tubers, besides small ones, are produced by each parent root; they are shaped somewhat like a cow's horn, but taper suddenly off, and terminate in a few small fibres; they have a diameter of 2 or 2½ inches in almost every part of their length, except the more tapering extremity; and the largest of them has usually a length of 8 or 9 inches. Different varieties of the plant have respectively white, yellow, and purple tubers; but all the varieties are quite or very nearly identical in nutritiousness, flavour, and other principal properties. In the district around Santa Fé, where the plant is indigenous, and where its tubers are as universally used for food as those of the potatoe are in England, it is propagated by planting pieces of the root, each containing an eye or shoot, and it acquires in three or four months a sufficient size and ripeness of tuber to be suitable for culinary purposes, and, when allowed to grow during six months, increases the tubers to a vast size without any deterioration of their flavour. Mr. D. Fanning of London, describing in 1829 the mode of cultivating the plant in the Caraccas, says, "Take a young plant or sucker, and cut it close to the top, leaving only two leaves on it. After it is cut, let it remain a day or two in the shade, in order to allow the cut part to heal. Plant them out early in April, about two feet apart, on the top of drills, barely placing the plants in the earth. Let them remain thus till the latter end of August or beginning of September, when the roots will be fit for use. Then take up both root and plant, and place them in a warm dry situation until April, and then prepare again for planting as stated above." The mode of experimental cultivation in England, is in deep black mould, in a temperature as nearly as possible ranging between 55° and 62°. Mr. Hamilton, at Plymouth, where the mean temperature of the month of July is 63° 50', found his experimental aracacha plant to grow more luxuriantly in the open

air than in the house, and to thrive and flourish beyond his most sanguine expectation.

The tuber is tender, and easily cooked, and is prepared for food in the same manner as potatoes, but requires to be very thoroughly boiled. It is grateful to the palate, congenial to the stomach, and at once so nutritious and so easy of digestion as to be a fit principal aliment to young children, sick adults, and all persons of feeble or impaired powers of digestion. Its flavour has a medium character between that of the potatoe and that of the parsnip. Some persons relish it, and others rather dislike it, at the first time of tasting it; but even the latter speedily relish it, and all persons like it increasingly the longer it is used. A fecula manufactured from it is employed as both starch and pastry-flour; and the pulp of it enters into the composition of certain South American fermented liquors, which are supposed to be efficacious as tonics. The tubers have been thought to resemble in flavour and other properties the small, sweet, pleasant, farinaceous, nutritious tubers of the great earth-nut, *Bunium bulbocastanum*, and *Bunium flexuosum*, so well known in many of the dry pastures of Great Britain, and so greedily sought after and highly relished by hogs and children.—*Curtis's Botanical Magazine*.—*Loudon's Gardener's Magazine*.—*Repository of Inventions*.—*Quarterly Journal of Agriculture*.

ARACHIS,—popularly *American Earth-nut*. A genus of annual plants of the pea tribe. The species hypogæa or underground is the only one well known; it derives its name from the curious circumstance of the pods forcing themselves into the soil, and there ripening their seeds; it was introduced to Great Britain from South America in 1712; it is supposed to be a native of Africa, and to have been taken by slaves to the new world; and it is profusely cultivated in all the warmer parts of both South and North America. Its seeds are used in South Carolina as a substitute for chocolate; in eastern countries, as a substitute for almonds; and in Cochin-China, for the expression of an oil which feeds lamps and serves the same purposes as oil of olives. In the district around Paris, the plant is raised on hot-beds, and transplanted to the open gardens, there to ripen its pods for use in the same manner as other esculent legumes; and in England, it has been brought to maturity, and proved very prolific, in the stove. Its stem attains the height of two feet; its branches trail upon the ground; its flowers are yellow, appear in May and June, and are produced singly on long foot-stalks; and its pods so completely bury themselves in the soil that, unless the ground is opened, they cannot be found. The negroes are said to have known its burrowing habit during many years before their masters, and to have surreptitiously helped themselves to its seeds.

ARALIA. A genus of plants, nearly allied to the umbelliferous family, and forming the type

of the order Araliaceæ. The most conspicuous species is the **ANGELICA-TREE**, which has been noticed in its own alphabetical place; three other species, the hispid, the berry-bearing, and the naked-stalked, all deciduous ornamental plants and natives of North America, the first an under-shrub, the second an herb, and the third a climber, have been introduced to the gardens of Britain; a fifth species, the umbel-bearing, exudes an aromatic gum resin from its bark; and about twenty-seven other species are known to botanists.—The tribe Araliaceæ comprises the genera *aralia*, *cassonia*, *hedera*, *actinophyllum*, *gastonia*, and *panax*; it is nearly allied to the extensive order umbelliferae; it possesses much beauty of foliage, particularly in the ivies and the actinophyllums; it has generally tonic roots, with, in some instances, the flavour of the parsnip; and, except in its fruit, it closely agrees in medicinal properties, as well as in other matter, with the great umbelliferous family.

ARAUCARIA. See **AURACARIA**.

ARBEEL. See **ABELE**.

ARBITRATION. A private mode of deciding differences, by a voluntary reference of disputed claims to the decision of one or more persons named as arbiters by the parties. This method of terminating disputes certainly deserves encouragement, on account of its tendency to diminish expense to parties, and to allay that heat and animosity which is too often produced and fostered by the proceedings in a public court of justice. The decision or award of the arbiters proceeds upon a deed of submission, which is a contract entered into by the parties, whereby they fix and determine the matters in controversy, define the powers of the arbiters, and mutually bind themselves to abide by the award.

Experience having shown the great advantage of these peaceable and private tribunals—especially in settling matters of account, and other mercantile transactions, which it is extremely difficult to adjust on a trial at law—the English legislature established the use of them by statute 9 and 13, William III., c. 15, which enacts, that all merchants and others, who desire to end any controversy, (for which there is no other remedy but by personal action or suit in equity,) may agree that their submission of the suit to arbitration or umpirage shall be made a rule of any of the king's courts of record; and after such rule made, the parties disobeying the award shall be liable to be punished as for a contempt of the court, unless such award shall be set aside for corruption or other misbehaviour in the arbitrators or umpire, proved on oath to the court within one term after the award is made. And in consequence of this statute, it is now become a considerable part of the business of the superior courts, to set aside such awards, when partially or illegally made; or to enforce their execution, when legal, by the same process of contempt as

is awarded for disobedience to such rules and orders as are issued by the courts themselves.

When a submission is made to two or more persons as arbiters, it is usual to stipulate, that another person shall be called in as umpire, (*imperator* or *impar*; in Scotland, *oversman*), in case of disagreement; to whose sole judgment the dispute is then to be referred.

The decisions of arbiters have been at all times so favourably viewed that among most nations they are not reducible on the ground of injustice or iniquity, but only on the ground of corruption. By the old practice of Scotland, indeed, decrees-arbitral were reducible on the head of iniquity in the judge, or of enormous lesion of the party; but by act of regulations 1695, c. 25, it was declared, that no decree-arbitral, proceeding on written submission, should for the future be reducible on any ground but those of corruption, bribery, or falsehood. Of course all decrees in which the arbiters have exceeded the powers committed to them, are reducible; they may also be challenged when the arbiter has not fully heard parties, or where he has taken proof in absence of one of the parties, or pronounced a decision palpably at variance with the principles of justice.

Arbiters are but private persons, in whom the law has vested no jurisdiction; and, hence, they cannot compel witnesses to appear and depose before them, or possessors of writings to exhibit them. But this defect is supplied in Scotland by the court of session, who, at the suit either of the arbiters, or of either of the parties, are in use to grant warrants in course for the citing of witnesses, or for the exhibition of writings before the arbiters.

As arbiters derive their whole powers merely from the consent of the parties submitting, their award or decree, if it be not given in strict conformity to those powers, is null, not being founded upon any proper authority. Hence arbiters cannot inflict, on the parties submitting, any penalty or fine higher than that which they themselves have agreed to in the submission. Hence also, if the parties submitting limit the power of the arbiters to any fixed day, decree cannot be pronounced after that day; though it may, *in ipso termino*, i. e. on the very day betwixt and which the arbiters had powers given them to decide. Where arbiters take upon them expressly to determine points not referred to them, the decree-arbitral may be declared null, upon an action of reduction, as being pronounced *ultra vires compromissi*.

ARBOR VITÆ,—botanically *Thuja* or *Thuya*. A genus of ornamental evergreen trees, of the cone-bearing tribe. It takes its popular name from the circumstance of its tree being very eminently evergreen, and not from any allusion to the tree of life in the Garden of Eden; and it takes its botanical name, which means sacrificial, from the circumstance of the timber of some of its species giving out an agreeable odour when

burnt, and having been used in the ancient rites of sacrifice. Nine or ten species of it are known to botanists; but only six have been introduced to Great Britain; and only two of these six, together with one well-defined variety, are in general British cultivation.

The American or common species, *Thuja occidentalis*, is a native of North America, and was introduced to Great Britain in 1596. It was, for upwards of 150 years, the only species known in this country; and though now less esteemed for ornamental purposes than some other species, it still continues pre-eminent for purposes of utility. It usually attains a height of about 25 feet, and occasionally rises to the height of 30 or even 40 feet; but is generally grown in this country only as a tall shrub or miniature tree. In its youthful or shrub-like condition, it is decidedly ornamental; and though of sombre and almost lugubrious character—suited more to the cemetery than to the pleasure-ground—it very effectively contrasts with plants of lighter outline, gayer aspect, and less unusual foliage; and, in consequence of having a full appearance, and yet flowering in feather-like tuftlets, it gives great richness to promiscuous or heterogeneous masses of shrubs. Its leaves are imbricated, and, as compared to those of most of other cone-bearing trees, seem broad, elaborate, and arabesque; in an advanced state of the tree, they become much thinned or scattered; and, when bruised, they emit a strong and, to many persons, very disagreeable smell. In Canada, it grows as a forest-tree, and is universally regarded as furnishing more durable timber than any other tree. Its trunk is sawn into planks and boards for the building of houses and boats; its branches are used for posts and fences; its smaller branches and its spray are used for making besoms; and its leaves are employed as the chief ingredient of a salve which the natives apply for the cure of rheumatism. Fences made of it last three or four times longer than those constructed of any other wood. In England, its timber has been used principally by the cabinet-maker and the turner. Michaux asserts this timber to be exceedingly durable; and Hanbury—speaking more, however, from theory than from experience—says, “the wood is reddish, firm, and resinous, so that we may easily judge of its value for curiosities of most sorts, when worked up by the respective artificers of turnery, joiners, cabinet-makers, &c.” The finest trees are always raised from seed; but very good trees may be raised from either layers or cuttings. The seeds, used for raising plants, ought to be sown as soon as ripe or early in spring, in pots filled with a mixture of peat and loam. The plants grow best in moist sandy loams, yet will become decidedly fine trees either in dry sandy soils or in damp clayey lands. The young plants will be most advantageously removed from the pots to the open ground in October, yet may be removed in any of the months of winter or spring; and they ought

to be planted at the distance of only a yard from plant to plant, and afterwards thinned and managed according to their several hardiness and growth. The first arbor vitæ introduced to Europe was planted in the royal grounds at Fountainbleau in the reign of Francis I. In 1780, an arbor vitæ at Bargoly in Galloway, measured 5 feet 4 inches in girth; and at a meeting of the Prussian Horticultural Society in 1830, a paper was read giving an account of an arbor vitæ at Heidelberg 212 years of age.

A well-established variety of the American arbor vitæ is denser or more ramified and compact than the normal tree, and has the botanical name of *densa*, and the popular one of close-branched. Another variety, if indeed it be not the same as the preceding, was discovered by Mr. Hanbury, and called by him the American sweet-scented arbor vitæ. He says respecting it, "It came up from some scattered seeds at the bottom of a box I had from Pennsylvania. It has the same dusky look in winter as the common sort, though it is better furnished with branches; neither are they produced so horizontally, or hang down in the manner of the common sort. What makes this sort most valuable is the property of its leaves; for being bruised, they emit a most refreshing odour, which is by many supposed to be as fine aromatic as any we have."

The Chinese arbor vitæ, *Thuja orientalis*, is a native of China, and was introduced to Great Britain in 1752. It is much more beautiful than the American species, and has, in a very great degree, superseded it as an ornamental plant. Its branches are more numerous, grow in a more erect manner, and are more picturesquely grouped, and they have a smooth and light brown bark; and its leaves are smaller and more numerous, and have a pleasant, light green colour. Fougereux regarded this species as the *Thuja* of Theophrastus. The jointed arbor vitæ, *Thuja articulata*, is a native of Barbary, grows 15 feet high, and was introduced to Great Britain in 1815; the African arbor vitæ, *Thuja cupressoides*, is a native of the Cape of Good Hope, grows to the height of 10 feet, and was introduced to Great Britain in 1799; but both of these species are tender, and require to be cultivated, the latter in the greenhouse, and the former in the frame. Three other species or varieties have recently been introduced,—the plaited arbor vitæ, *Thuja plicata*, from Nootka Sound; the weeping arbor vitæ, *Thuja pendula*, from Tartary; and Lucas's arbor vitæ, *Thuja Caroliniana*, from Carolina. But several un-introduced Chinese and Japanese species and varieties which have recently become known to botanists, are said to possess great beauty, and would be fine accessions to our woods, shrubberies, and parks. *Thuja dolabrata*, in particular, is described by Kœmpfer and Thunberg, who saw it in its native soil, as a vast, lofty, and beautiful tree, the fairest of all the evergreens; and it grows in such latitudes as indicate that, if brought to Britain, it would

prove to be perfectly hardy.—*Loudon's Encyc. of Plants*.—*Miller's Gardener's Dictionary*.—*Marshall on Planting*.—*Nicol's Planter's Calendar*.—*Gilpin's Forest Scenery*.—*Dictionnaire d'Histoire Naturelle*. Paris 1819. Tom. xxxiv.

ARBORETUM. A systematic garden collection of ligneous plants, or of trees and shrubs. Specimens of about 2,500 species of trees and shrubs, exclusive of roses, are requisite for the formation of a complete *Arboretum Britannicum* or collection of all the kinds which are at present growing in Great Britain. Such a collection may be so disposed, on the principles of landscape gardening, as to produce a numerous and elaborate series of most imposing and picturesque groupings: but it undoubtedly better serves the purposes of science and utility, when tastefully arranged on the principles of systematic botany; and, in either case, but especially in the latter, it ministers largely to the knowledge and enjoyment of all persons who have access to it, contributes valuable information to the farmer, the gardener, the forester, the nurseryman, the young botanist, and the general student, and makes visitors feel as if wandering in other climes, conversing with other nations, and looking in succession upon the woody wildernesses of America, the icy tablelands of Tartary, the savannahs of the Missouri, the eternal snows of the Himalaya, and the untrodden forests of Patagonia. Scotland and Ireland are dismally poor in arboreta; and even England is far from being rich. Two of the best in our country are one at Derby and one in the grounds of the London Horticultural society; and several very good and comparatively extensive ones exist in connexion with nurseries, particularly in the vicinity of London.

"The Derby arboretum," says Mr. Loudon, "is situate in the outskirts of the town; the extent about 11 acres; the form long, narrow, and irregular; the surface is flat, apparently level, but with a very gentle inclination from the north-east to the south-west; and the soil is loamy, on a gravelly or loamy subsoil. The situation is open, but not much exposed to high winds; water is to be found at the usual depth to which wells are dug, and there is one small pond which is never dry at any period of the year. Every part of the ground admits of drainage; but all the drains must terminate at the south-east corner, where alone the water can escape. The soil is particularly well adapted for the growth of trees, as is evident from the belt which surrounds great part of the grounds, and which was planted some years ago by Mr. Strutt. The most important feature in this piece of ground, with reference to its adaptation for a garden of recreation, is, that there is no distant prospect, or view beyond the grounds, worthy of being taken into consideration in laying them out; or at least none that may not, in a very few years, be shut out by the buildings of the town, which are increasing fast on every side. The instructions given to me

by Mr. Strutt respecting laying out this public garden were, that it was intended to be a place of recreation for the inhabitants of Derby and the neighbourhood, and for all other persons who chose to come and see it; that it should be open two days in the week, and that one of these days should be Sunday, during proper hours; and that on other days a small sum should be required from persons entering the garden; or yearly admissions should be granted for certain moderate sums. That the gardens should be so laid out and arranged as not to be expensive to keep up; that a flower-garden and cottage, with the plantations already existing, should, if possible, be preserved; that a tool-house covered with ivy should also be preserved; that two lodges with gates, at the two extremities, should be built; and that each lodge should have a room, to be considered as a public room, into which strangers might go and sit down, taking their own refreshments with them, without any charge being made by the occupant of the lodge, unless some assistance, such as hot water, plates, knives, and forks, &c., were required, in which case a small voluntary gratuity might be given. That there should be proper yards and conveniences at each lodge for the use of the public, apart from those to be exclusively used by the occupant of the lodge. That there should be open spaces in two or more parts of the garden, in which large tents might be pitched, a band of music placed, dancing carried on, &c. That certain vases and pedestals now in the flower-garden, and also certain others in Mr. Strutt's garden in Derby, should be retained or introduced; and, finally, that some directions should be left for the management of the garden."

One of the nurseries at Camberwell may be referred to for illustration of what an arboretum is, what private enterprise can effect in forming one, and what benefits might result from planting one on even a limited scale on every large estate. It was founded in 1830, and noticed as follows, in July of next year, by Mr. Loudon:—"We are most happy to state that Mr. Buchanan, junior, by extraordinary exertions during last autumn and winter, has collected together upwards of 600 species and varieties of trees, and more than 1,200 species and varieties of shrubs. These he is now arranging on both sides of a winding walk, on borders 8 feet broad, and which, when united, form a length of 320 feet. The shrubs are placed in three rows in front, and ranged into three classes according to their heights: the trees form one row behind the shrubs. Both trees and shrubs are arranged alphabetically. The average distance between the trees is 3 feet; but, not being crowded on either side, the extension of their branches will not be interrupted in two directions, though it will in the direction of the line. Though the shrubs are planted in three rows, yet each genus is kept by itself; the tallest of the species being planted in the row farthest

from the walk, the shortest next the walk, and the intermediate sizes in the line between. When all the shrubby species of a genus are tall, they are placed in the third row; and when they are all short, in the first row; and the sizes are so distributed that the three rows are tolerably equally filled. For example, all the *helianthemums* are planted in the first row, and they, of course, extend so far along that row as to allow of several genera being introduced in the two rows behind them. Much room is thus saved (which, in a nursery so near London, is an important object), and the alphabetical order still preserved. Each tree and shrub will be named according to the nomenclature of our *Hort. Brit.*, and on every tally, preceding the name, there will be a number. These numbers being all in regular series, should any tallies be taken out and transposed, they are easily replaced in correct order. As additions are made, the number of the species immediately preceding is put on the tally, with the addition of the letters of the alphabet in regular series, as exemplified in our supplement to the *Hortus Britannicus*."

It cannot be denied that much is lost, in a picturesque or ornamental view, by an attempt to arrange arboreous plants according to the affinity of their position in any system of scientific classification. It seems but fair to state the disadvantages of arboretums, in this respect, as freely as we have adverted to their utility; and this we cannot better do than in the words of Mr. Paxton in his 'Magazine of Botany.' The scientific arboretum, Mr. P. says, "creates a dull monotony, and a slovenly displeasing irregularity; two extremes equally to be deprecated in landscape gardening. Paradoxical as this may appear, it is not the less correct. The uniformity alluded to is local, differing widely from comprehensive unity, it is confined to the different beds or plots set apart to the species of certain genera or tribes. These frequently assimilate so closely to each other in appearance, that in one place will be seen a bed of trees all evergreens; in juxtaposition a cluster of dwarf shrubs, all flowering at the same time, and equally near; but in the opposite direction a group of the largest kind of deciduous trees. All these are monotonous in themselves, while viewed in connection and comparison with each other they present a total look of congruity.

"Nothing can be more adverse to genuine principles of landscape disposition than the system above described. Diversity of outline, of the form, colour, season, and duration of the foliage and flowers, is absolutely essential to the beauty of any scenery. Without this it appears sombre, formal, constrained, in one word, *unnatural*; and much as the imitation of nature has been despised by mere theorists, it is and must be the system pursued by all who would attain any eminence in this art. On the other hand, let it not be forgotten that a garden is the medium which asso-

ciates artificial with natural objects; the dwelling with the surrounding country. In precise accordance with this design, therefore, should be its arrangement and appearance. Trees growing in extension groups, *en masse*, or even arboretums planted without regard to the size, the appearance, or the general character of the plants, are inadmissible and intolerable where all is required to be harmonious, and to a certain extent comfortable.

"In planting ornamental trees and shrubs (and no others should be allowed a place in the pleasure-ground), they should if possible be so arranged as to stand quite distinct of each other, that every one may be witnessed and examined apart from the rest, without suffering any detraction from having all parts of its surface exposed. They must likewise be so blended, associated, and intermingled, that when viewed at a distance, they may present the appearance of an agreeable and diversified mass of verdure. These two apparently remote objects may yet be concurrently accomplished. In parterres or shrubberies, of whatever dimensions or extent, a due regard to the known character or known habits of the plants employed, will enable the gardener to place them precisely at such distances as will allow them full room for their full and complete extension, without becoming entangled with other plants, or if the smallest of the plot or diminutive size of the plants preclude this arrangement in the first instance, without derogation from the appearance of the group, they can be planted so as to admit of any subsequent thinning to the required extent. Shrubberies thus planted with exotic trees only would be in themselves arboretums, and if that charming variety which can alone please the eye be consulted and effectuated, none of the objections we have before urged against those departments would apply in this case. It is true that species, and even genera, would thus be separated and scattered promiscuously throughout the group, so that it would be almost impossible to trace their associations. Pleasure-gardens are not, however, nurseries for botanists; at least, we imagine, few proprietors of them would entertain and follow out such an idea, at the expense of everything that would render them attractive and picturesque."

ARBUTUS. A genus of beautiful evergreen shrubs and under-shrubs, of the heath tribe. The common species, or strawberry-tree, is indigenous in the south-west of Ireland, and everywhere cultivated in the shrubberies of Great Britain; the bear-berry species grows wild on heathy mountainous grounds in Scotland and England; the black-berried species grows wild on the Scottish mountains; five foreign species have been introduced to our shrubberies and greenhouses from the Canaries, the Levant, and Peru; and six other species are known to botanists. The popular name strawberry-tree, applied to the common species, alludes to the close resemblance which

the fruit, in colour, shape, and size, possesses to a strawberry.

The common species, *Arbutus unedo*, is one of the most beautiful of hardy shrubs; it shows little of the sombreness of most evergreens in summer, and displays the brilliance of one of the richest of evergreens in winter; and it is covered with both blossoms and ripe fruits in October and November, and is thus one of the most charming objects in the vegetable world. It is a native of only Spain, Italy, and the south-west of Ireland; it grows in the last of these countries as plentifully and luxuriantly as in the kingdom of Naples; it particularly abounds in the limestone glens and slopes of the magnificent mountain basin of the Kerry lakes: and it frequently spreads out in such sheets, and soars aloft in such altitude, as to give a decided tint and character to large groupings or expanses of the gorgeous scenery. Though it rarely attains a height of more than 10 feet in British gardens, and can with difficulty be maintained as a mere tiny shrub in some situations in Scotland; yet, in its wild state in Kerry, it often attains a height of between 20 and 30 feet, and occasionally a girth of between 8 and 9 feet. As grown in the shrubberies and villa-grounds of Britain, it is usually a tall shrub, and may be kept down to any size. Its stem is covered with a light brown, rough, and falling bark; its branches have a colour approaching to purple; its fresh shoots are of a red colour, and a little hairy; its leaves have an oblong oval form, are smooth and beautifully serrated, stand on short footstalks, and grow alternately on the branches; its older leaves contrast with the younger by having their footstalk and midrib of a fine scarlet colour; its flowers, according to the variety, are white, whitish-yellow, and pink, but do not of themselves make any considerable show; and its fruit pass through a whole twelvemonth in the process of growing and ripening, appear when ripe like very large red strawberries, are used by the Spaniards for the manufacture of a sugar and a spirit, and, though decidedly repugnant in taste and flavour to most persons, are eaten by the peasantry of Kerry south of Italy.

Several well-established varieties of the common arbutus are extensively cultivated, and have been fully recognised by both the nurseryman and the botanist. The entire-leaved variety, *Arbutus integrifolia*, is characterized by the even-edgedness of its leaves, produces pink-coloured flowers, and attains little more than one-half the height of the normal or parent variety.—The oblong-fruited variety is characterized by the largeness and oblongity of its flowers, and the largeness and oval-shapedness of its fruit; it attains the greatest height, and makes the noblest figure of any of the varieties; and it even occasionally contributes its timber to various purposes of utility.—The round-fruited variety differs from the preceding only in having pitcher-shaped flowers, and round-shaped fruit.—The red-

flowered variety, *Arbutus rubra*, differs from the oblong-fruited and the round-fruited, principally in its flowers being red, while theirs are white or yellowish-white.—The double-flowered variety, *Arbutus plena*, is distinguished by the smallness of its stature and the doubleness of its flowers. Yet the latter character is very trivially developed, and does not challenge attention except when the flowers are closely examined.—The parent species is best propagated from seeds; and all the varieties may be propagated by either layers or cuttings.

The oriental species, *Arbutus andrachne*, is a native of the Levant, and grows so plentifully about Magnesia as to be the principal fuel used by the inhabitants. Its branches are irregular; its leaves are large, oval, smooth, entire, free from serratures, and somewhat resembling those of the bay tree, but not so long; its flowers appear in March and April, and are shaped like those of the common arbutus, but grow thinly on the branches; and its fruit is oval, and of the same colour and consistency as that of the common sort. Its trees or shrubs make a finer appearance than any variety of *Arbutus unedo*; yet though quite hardy when old, they are tender when young, and require to be reared for three or four years in pots, and afterwards planted in a warm situation and on dry soil. A plant of this species, as cultivated in Great Britain, usually attains a height of not more than six feet; but a plant of it in the botanic garden of Edinburgh very greatly exceeds that height, and is singularly massive in form and novel in appearance. This plant was removed from the old Botanic garden in 1822, and was accurately measured both then and in 1836, and was supposed, at the latter date, to be not less than from 30 to 40 years old. In 1822, its height from the surface of the ground was 13 feet, and the diameter of its branches in one direction 9 feet, and in another 16½ feet; and, in 1836, its height from the surface of the ground was 19 feet, and the diameter of its branches in one direction 16½ feet, and in another 23 feet. Three principal branches, diverging from the stem and from one another immediately above the surface of the ground, bore all the body and head of the plant; and, in 1836, these measured in girth respectively 3 feet, 2 feet, and 1 foot 11 inches.—The hybrid species, *Arbutus andrachnoides* or *Arbutus hybrida*, has frequently been mistaken for the oriental species, and somewhat closely resembles it in both appearance and habit. Certain plants in the Marquis of Ailsa's gardens at Culzean, which have attained considerable notice as specimens of oriental arbutus, really belong to the hybrid species.

The bearberry species, *Arbutus uva ursi*, is a ligneous creeper, and rarely attains a height of more than six inches. It grows wild, not only on the mountains of Great Britain, but also on those of Spain, North America, and the north of

Europe. Its branches are numerous and minutely ramified; its leaves are thick, smooth, oval, and alternate; its flowers are produced in small bunches toward the extremity of the branches; and its berries are red in colour, and smaller in size than common black cherries. Plants of this species naturally grow on boggy ground, in very cold situations, exposed during the whole of winter to frost and snow; and when introduced to gardens, they seldom prosper or continue except when planted upon cold patches of artificially-placed bog. Their bark tans leather, and dyes cloth an ash colour; their berries are food for grouse and other game; and their leaves, when fresh, are inodorous, have a slightly bitter astringent taste, and leave upon the palate a sensation of sweetness,—and, when properly dried and powdered, they acquire an odour similar to that of hyson tea, and have been used, in medical practice, in cases of nephritic calculus, pulmonary disease, ulcerations of the urinary organs, menorrhagia, cystirrhœa, and diabetes.—The black-berried and the phyllyrea-leaved species, *Arbutus alpina* and *Arbutus phyllyreaefolia*, the former Scottish and the latter Peruvian, are dwarfish undershrubs, seldom attaining a height of more than six inches; and both they and the bearberry species, assort excellently with the dwarf species of andromeda and rhododendron, for what gardeners technically term rockwork.—*Miller's Gardener's Dictionary*.—*Smith's Description of Kerry*.—*Fraser's Guide through Ireland*.—*Loudon's Gardener's Magazine*.—*Marshall on Planting*.—*Thomson's Dispensatory*.

ARCHANGEL, botanically *Lamium*. A genus of herbaceous plants, of the labiate family. Three species are natives of Great Britain; eight species have been introduced from Italy and the Levant; and eight other species are known to botanists. The balm-leaved species, *Lamium orvala*, a native of Italy, and a perennial, is grown for ornament, flowers in May and July, and has a height of about twenty inches. The purple species, *Lamium purpureum*, is an annual weed of Great Britain, grows on waste grounds, has a height of about a foot, and produces puce-coloured flowers from May till August. The cut-leaved kind, *Lamium incisum*, appears to be a variety of the purple species, grows on sandy fields, and produces pink-coloured flowers from May till July. The species popularly called henbit, *Lamium amplexicaule*, is also an annual weed of the sandy fields of Britain, grows to the height of 9 inches, and produces pink-coloured flowers from March till June. The white species, *Lamium album*, is a perennial weed of Britain, grows on waste grounds, in fields, and at the side of walls and hedges, has a height of two feet, and produces large white flowers from April till September. This last species is the most conspicuous, and frequently shares with the galeobdolon the popular name of dead-nettle. Its leaves some-

what closely resemble those of the common nettle, but do not sting. The plant, when rubbed, has a disagreeable smell; and though it is carefully avoided by all cattle, it is said to be used by the people of Sweden as a spring pot-herb. It has been recommended as an admirable poultice, when bruised with vinegar, for wens and hard swellings.

ARCTIUM. See BURDOCK.

ARDERS. A provincial name for frequent or fallow ploughings of land.

ARECA. See CABBAGE-TREE.

ARENARIA. See SANDWORT.

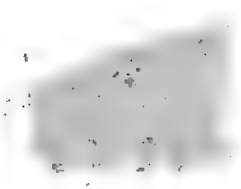
ARETIA. A genus of small, evergreen, herbaceous, ornamental plants, of the primrose family. Three species, *helvetica* and *alpina* from Switzerland, and *vitaliana* from the Pyrenees, are cultivated in the gardens of Great Britain; and six other species are known to botanists. The introduced species are excellently adapted for rockwork; yet, though hardy, are sufficiently delicate to require good air and nice cultivation.

ARGALI. A group of wild animals of the *Ovis* or Sheep genus. They seem, jointly with the musmon of Greece, Crete, and Cyprus, to have been the parent-stock of all the numerous and diversified races of domestic sheep. Five distinct species or varieties of argali have been observed by naturalists in the old world, and two in America. The Siberian argali, *Ovis ammon*, inhabits the mountains and elevated plains of Asia, from the Caucasus eastward to Kamtschatka, and northward to the ocean, and has been very fully described by Dr. Pallas. The Kamtschatkan argali, *Ovis nivicola*, abounds on the mountains of Kamtschatka, residing on the snow-clad heights in summer, and descending to lower regions in winter, and has been particularly remarked by Kotzebue for its agility. The Caucasian argali, *Ovis cylindricornis*, inhabits the Caucasian mountains, and though, till a few years ago, confounded by all naturalists with the Siberian argali, has been ascertained by Mr. Blyth to be a perfectly distinct variety; the Armenian argali, *Ovis Gmelinii*, occurs only on the highest mountains of Persia, and has been described by the naturalist Gmelin, after whom it is named; the Persian argali inhabits the central regions of Persia, but, though noticed by Sir John MacNeill, and believed to be very observably the parent stock of a portion of the vast tribe of domestic sheep, has not as yet been scientifically described; the Rocky Mountain argali, *Ovis montana*, inhabits the rocky mountains in the interior of North America, in about the 50th degree of north latitude; and appears to have extended along this range into the region of California on the west coast of North America.

The Siberian argali has been more closely observed, and more amply described, than any of the other varieties; and, for these reasons, as well as on account of its more extensive diffusion, it may be noticed as the type of the whole

group. The male is larger, and in all respects stouter, than the female. He resembles a small stag in height and general proportions, but is much more robust and nervous in body, shorter in the legs and neck, and less elegant in form. His head resembles that of a domestic ram, with long straggling hairs about the mouth, but no beard. His ears are rather smaller than those of the ram; and his tail is very short. His horns are of enormous size, and remarkable shape and curvature, measure more than a foot in circumference at the base, and between three and four feet in length from the base to the tip, rising triangularly from the crown of the head, nearly touching each other at the base, extending upward, outward, downward, and again outward, so as first to describe nearly a semicircle, and then to terminate in pointed horizontal extensions. His summer coat consists of short hair, sleek, and similar to that of a deer; and his winter coat consists of wool-like down, mixed with hair, everywhere at least an inch and a half in length, and concealing among its roots a fine, woolly, white down. The colour of the fur is brown in summer, and brownish-gray in winter; but a buff-coloured streak passes along the back, and a large spot of lighter-coloured buff occurs on the haunch, and surrounds and includes the tail. The horns of the female, however, are more slender and less curved than those of the male; and the haunch wants the buff spot, and is uniform in colour with the rest of the body. The lamb resembles a young kid, but has a large flat protuberance in place of horns, and is covered with a woolly, frizzled, dark-gray hair.

The argalis are strong and agile, but very timid; they shun the vicinity of man, and flee on the smallest appearance of danger; and they run in a zigzag course, and, like domestic sheep, occasionally stop to gaze upon their pursuer. They are usually found in very small flocks; and are hunted by the Siberians and Tartars for their flesh, which is esteemed to be savoury, and for their skins, which are made into clothing. In autumn, after having pastured throughout the summer, on the grassy mountains and in the secluded valleys, they are fat and in high request; but, as winter advances, when they are compelled to leave their summer haunts in search of food, they lose their plumpness, and are valued chiefly for their skins. When caught young, they are easily tamed; but when not caught till an advanced period of their life, they never lose their wildness. They delight in full and constant exposure to the sun and weather; and, in consequence, avoid the woods of the mountains, and frequent bare, bleak, and rocky heights. Their principal food consists of such grasses, herbs, and shrubs, as they find growing in the interstices of rocky ground; and they purge themselves in spring with acrid plants, as an instinctive preparation for salubriously passing from the hard fare of winter to the mild and



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1. The first group of authors (see Table 1) has been concerned with the question of whether the use of a particular type of stimulus (e.g., a picture) is more effective than another (e.g., a verbal stimulus) in eliciting a particular response (e.g., a verbal response). This is the question of the relative effectiveness of different types of stimuli.

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1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

1. The first group of people who are likely to be affected by the proposed changes are those who are currently employed in the public sector. This group includes civil servants, teachers, nurses, and other public employees. They will be affected because the proposed changes will likely result in a reduction in public sector employment.

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1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

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1. The first step is to identify the key components of the system. This includes understanding the hardware, software, and data involved.

nutritious herbage of summer. They likewise frequent the salt marshes which everywhere abound in Siberia, and even lick the saline efflorescence which rises on the ground; and, from the effects of the salt upon their constitution, they speedily acquire plumpness, and regain vigour, flesh, and firmness which they had lost during the low feeding of winter and the purging course of spring.

The Armenian argali is allied to the Corsican mouflon, and seems less remote from the domestic sheep in configuration and habits than the Siberian argali. Specimens of it from Erzeroum may be seen in the gardens of the London Zoological society. The males are very pugnacious with one another, and have been known to strew a spot with their horns, knocked off during their contests."

The argali of the Rocky mountains of America—figured in *Plate IV.* of our work, Nos. 2 and 3—is well known to the Indians and fur-traders of Canada. It is larger than any of the argali of the old world, and consequently taller than the largest of our domestic sheep. Its fur during summer is of a grayish fawn, generally having along the back a deeper yellow or reddish line. The fur of the old rams in spring is nearly white. The face and the nose are white; and the tail and haunches are distinguished by the same kind of buff-coloured disc as the argali of Siberia. The horns of the male are very large, and approach, yet do not touch one another at the base; and the horns of the female are small and slightly curved. These animals live and move in flocks, under the guidance of a leader; they pasture on the steepest parts of the mountains in summer, and descend into the plains on the approach of winter; they are wild and timid, and flee, on the least alarm, to the most inaccessible parts of the mountains; and they are hunted and killed by the Indians for the sake of both their flesh and their skins.

Africa has its argali, and in all likelihood more than one variety of the species; for it does not appear that the specimen described by Dr. Caius, and that discovered by M. Geoffroy St. Hilaire in the mountains of Egypt, can be viewed otherwise than as varieties of the same species; that figured by Mr. Pennant may be altogether distinct. The *O. Tragelaphus*, described by Caius about 1561, brought from the mountains of Mauritania, Morocco, was larger than a fallow-deer, or nearly equal to a stag, being three feet six inches at the shoulder, and four feet six from the nape of the neck to the tail. The head, from the nostrils to the vertex, one foot three inches; the horns one foot one inch and a half in circumference at base, one inch asunder on the head, bending back and downwards, angular, black, two feet one inch long, and wrinkled; the ears small; a beard formed by hairs on the cheeks, and under-jaw dividing into two lobes; the neck thick, of no great

length, and beneath it a quantity of long hairs hanging from the throat to the knees; a setaceous mane stood up along the neck, and in particular about the withers, where it was tufted, long, and erect, and of the same colour, or somewhat darker than that of the rest of the body, which resembles the winter dress of a stag, or blackish-rufous; the knees, protected by long and dense hairs which seem intended to protect them in bounding, were bent backwards, but without a callosity; the legs were slender, and the external hoofs of the fore-feet longer than the internal; the incisors were only six in number; the nostrils black, divided by a perpendicular line of the same colour. It was gentle, petulant, and lascivious, fond of ascending high places and roofs of houses; it could run swiftly and bound prodigiously. According to Caius the females are larger than the males, but are not provided with a similar luxuriant mane; but on this head he does not seem to speak from personal observation.

Pliny notices the musmon, musimon, and ophion. In Candia, it is said, the *O. Musmon* is still to be found. The mountaineers of Sardinia and Corsica are well acquainted with it, by the name of *mufro*, and in former ages it abounded in Spain, and, probably, in all the high primitive chains of mountains in temperate Europe. If one species of *ovis* can make a direct claim to the progenitorship of the domestic breeds more than another, it would be the musmon and the last-described variety of Africa, which by the structure of its horns is more allied to musmon than to ammon; both having proved that the intermixture with domestic sheep is readily accomplished, and the intermediate breed prolific. It is probable that African sheep first peopled the south and west of Europe, perhaps as early as the Asiatic, which may have spread themselves over Greece, Sicily, and the east of Italy; but a later period may be assigned to those which came round the Black sea into the valley of the Danube; the northern nations of wooded Europe could not maintain them till a period comparatively recent.

The Corsican musmon, like the African animal, has the horns shorter than the other argalis, usually not exceeding one and a half the length of the head, curved backwards, and the points turned inwards. In general the colour of the fur is a brownish or liver-coloured gray, with more or less white upon the face and legs; there is also a tuft of long hair beneath the throat, and a darker streak along the back and on the flanks. But they sometimes vary in colour, being marked with large black spaces, particularly about the neck, resembling, in this particular, the domestic breeds both in Africa and India, which appear to be nearest the original stock. The females are in general without horns, and of all the wild species of the sheep they have the chaffron most arched, and are said to be the least intelligent and hardy. Of the facility of breeding this

species with our domestic sheep, proof was obtained from the specimen brought to England by the celebrated Pascal Paoli, which was the parent of a mixed progeny here; hence, there is some ground to suspect that the musmon and ophion of the ancients were not synonymous names for the same animal, and that the wild sheep of Spain and the Carpathian mountains are not the mufro of Corsica. The Spanish wild sheep mixed however with the domestic, and the intermediate breed, according to Pliny, were named umbri. The musmons of Sardinia and Corsica never quit the highest ridges; where, however, the temperature allows no permanent snows. They live in small herds, headed by an old male, uniting occasionally into flocks of near one hundred; but they separate again in December and January, when the rutting season commences, and the usual battles have decided how many females each male can retain. The females yearn two lambs in April and May, which run about the moment they are dropped, and are cherished and defended with great constancy by their dams: they are not adult till the third year, but the power of procreation is the same as in the domestic races, and can commence at eighteen months. See article SHEEP.—*Dr. Pallas on Sheep.*—*Spooner on Sheep.*—*Low's Elements of Practical Agriculture.*—*Smith's Supplement to Cuvier.*—*Lewis and Clarke's Travels*, vol. i.—*Shaw's General Zoology*, vol. ii.—*Godman's Natural History*, vol. ii.

ARGEMONE. An annual medicinal plant of the poppy family. Two kinds of it are known, the yellow-flowered and the white-flowered; but they seem to be varieties of one species,—and both are from Mexico and the West Indies, and grow to the height of two feet. The argemone is called by the Spaniards the Devil's fig, and sometimes by Britons the prickly poppy. It is a very troublesome weed in the West Indies, yet is sometimes grown in British gardens as a curious ornamental plant. Its fruit has a fig-like appearance, and is armed with prickles. Its seeds are said to yield a narcotic substance as powerful as opium. A milky glutinous juice flows from the whole plant; turns, by exposure to the air, into a fine bright yellow; and when reduced to the consistence of a firm gum, is not distinguishable from gamboge, and has, we believe, been brought into the market under the name of that drug. It has similar properties to gamboge, both as a medicine and as a pigment; and it has been administered, in very small doses, in cases of dropsy, jaundice, cutaneous eruption, and some other diseases.

ARGILLACEOUS EARTH. Any earthy substance, whether soil or stone, powder or rock, sand or paste, which contains alumina, or has an admixture of clay. The soils called carse lands, and the rocks called claystones and clay-porphyræ, are the most conspicuous specimens of argillaceous earths; and all adhesive lands, loams,

and pasty or soluble soils usually contain a large proportion of argillaceous matter. Argillaceous earth, in all its varieties, always contains alkalis and alkaline salts, with sulphates and phosphates; and, in consequence, it is eminently fertilizing, or rather is an indispensable and bulky ingredient in all productive land. See ALKALIES, ALUMINA, and CLAY.

ARGILLACEOUS STONES. Nearly all the stones known to builders as slate-stone belong to this class. The most remarkable varieties are those denominated the *trap rocks* by mineralogists, which consist either of basalt, or greenstone. Basalt is very remarkable for its great strength and hardness; though it is less durable than many varieties of the siliceous class. Greenstone, so called from the greenish tint it exhibits when wet, is found very abundantly in Britain. It is a good building material, when it does not contain any large quantity of iron; this metal, by becoming oxidized, very soon entirely destroys the texture of the stone, causing it to break up into small fragments or scales. It is only suitable for rubble work, owing to its being found chiefly in small tabular prismatic masses; but from the facility with which it is quarried, and its unchangeableness in salt-water, it has been sometimes used for break-water stone. *Graywacke*, and *graywacke slate*, properly belong to the sandstones. They are composed of the fragments of several other minerals, in a granular state, united by an argillaceous cement. Both of these stones make a good building material for rubble work; and the graywacke slate is in very common use as a flagging and coping-stone. *Common roof slate* requires no particular description. There are many varieties of this stone which are very suitable for rubble work. The best for roof covering is that which splits into thin even layers,—which absorbs but little moisture,—and which is free from the ores of iron, particularly the sulphurets, which are most deleterious to it. Quarries of slate and slate-stones are abundantly distributed in various districts in England: but the best and principal supply of roofing slate is obtained from Caernarvonshire in Wales. The quarries of Green-moor in Yorkshire supply excellent paving flags,—as do also those of Valentia in Ireland, some of which are remarkably fine and durable.

ARIA, or WHITE-BEAM-TREE,—botanically *Pyrus Aria*. A species of timber-tree, closely allied to the pear-tree, the apple-tree, the service-tree, the azarole, and the hawthorn, and bearing blossoms of the rosaceous order. It was botanically classed, till lately, with the *cratægus* or hawthorn genus; and it is sometimes popularly called the White-leaf Tree, the Oval-leaved Wild Service, and the *Aria Theophrasti*. It grows indigenously on the hills of Kent and Surrey, and in most of the cold parts of Europe; and it attains a height of 40 feet, and blooms in May and June. Its stem is straight, symmetric, and freely

ramified; its branches are smooth, spotted with white, and seemingly powdered with the finest meal; its buds appear in winter, at the end of the branches and spray, swelled for the next year's shoot, and giving the leafless tree a bold and fine appearance; its leaves are oval, unequally serrated, about three inches in length, and an inch and a half in breadth, green on their upper surface, white on their lower surface, intersected with strong nerves from the midrib to the border, placed in alternations on the branches, and constituting, in their aggregate appearance, a very beautiful foliage; the flowers are white, and grow in large bunches, on mealy footstalks, at the ends of the branches; and the berries are red, and become ripper in autumn. This tree is a beautiful object at all seasons of the year, and forms a finely ornamental feature on the margins of plantations. Its timber is both hard and tough, and serves well for cart-axles, tool-handles, and other similar purposes. — *Loudon, Miller, and Marshall*,—the two last under the word *CRATEGUS*.

ARIL, or ARILLUS. A coat or an enveloping appendage of a seed. It invests the seed, in some cases wholly, and in other cases partially; but in no case does it closely adhere to the seed at any point except the base; and in every case it eventually detaches itself from the seed by spontaneous action, or by maturity of growth. It may be regarded as strictly an expansion of the umbilical cord. A beautiful example of it, as an entire envelop, occurs in the seed of the spindle-tree, *Euonymus Europæa*, where it exists as an outer and orange-coloured coat, and becomes very conspicuous to observation at the opening of the valves of the capsule; and a corresponding example of it, as a partial envelop, appears in the seed of the intimately allied genus of *celastrus* or the staff-tree. In the spindle-tree, it has a somewhat succulent texture; in the *oxalis* genus, it is membranaceous and elastic, and parts from the ripened seed with a considerable jerk; in a few species of *orchis*, it resembles a finely reticulated web; in most plants, it has either a membranaceous or a leathery sort of texture; and in the nutmeg-plant, *Myristica moschata*, it is fleshy, leathery, and reddish-saffron coloured, and, when separated and dried, is the well known mace of commerce.

ARISTOLOCHIA, — popularly *Birthwort*. A genus of ornamental and medicinal plants, forming with the *Asarum* or *Asarabacca* genus, the natural order *Aristolochiæ*. This order are situated on the extreme verge of the exogenous division of the vegetable kingdom, and approach closely, in structure and character, the endogenous division. Most of the plants which it comprises are herbaceous or half-shrubby, with simple, often reniform leaves, and with mottled, grotesque, and usually brownish-purple flowers. The roots of all are bitter, and possessed, in various degrees, of tonic and stimulating properties. Upwards of twenty

species of the genus *aristolochia* are cultivated as ornamental plants in the gardens of Great Britain; and about fifty other species are known to botanists. The common species, *Aristolochia clematitis*, grows indigenously in the woods of England, attains a height of two feet, is a perennial herb, and produces yellow flowers from May till August. The broad-leaved and the downy-leaved species, *sipho* and *tomentosa*, are hardy deciduous climbers to the height of respectively 30 and 20 feet, and were introduced from North America in 1763 and 1799. The Spanish species is also a hardy herbaceous climber to the height of 6 feet, and was introduced from Spain in 1596. The three-lobed, the greatest, the sweet-scented, the bearded, the Indian, and the glaucous-leaved species, *trilobata*, *maxima*, *odoratissima*, *barbata*, *Indica* and *glaucæ*, are tender evergreen climbers to the height of respectively 6, 20, 10, 10, 10, and 6 feet; and were introduced, the first from South America in 1775, the second from New Spain in 1759, the third from Jamaica in 1737, the fourth from Caraccas in 1796, the fifth from the East Indies in 1780, and the sixth from Barbary in 1785. The long-rooted, the Virginian snake-root, and the small species, *longa*, *serpentaria*, and *pistolochia*, are hardy deciduous trailing plants, of from 1 foot to 2 feet in height, and were introduced, the first from the south of Europe in 1548, the second from North America in 1632, and the third from the south of Europe in 1597. The evergreen and the bracteated species, *semper-virens* and *bracteata*, are tender evergreen trailing plants, grow to the height of respectively 4 and 3 feet, and were introduced, the former from Candia in 1727, and the latter from the East Indies in 1793. The speckled and the long-pointed species, *labiosa* and *acuminata*, are stove evergreen twiners, grow to the height of respectively 20 and 10 feet, and were introduced, the former from Brazil in 1821, and the latter from Mauritius in 1822. The round-rooted and the hairy species, *rotunda* and *hirta*, are tender evergreen herbs, grow to the height of two feet, and were introduced, the former from the south of Europe in 1596, and the latter from Ohio in 1759. The pale-flowered species, *pallida*, is a hardy perennial herb, grows to the height of two feet, and was introduced from Italy in 1640. The tree species, *arborescens*, is a tender, tall, evergreen shrub, grows to the height of 20 feet, and was introduced from America in 1737.—The roots of the Virginian snake-root species have a place in the *Materia Medica*, and are well known to every vender of drugs; they possess an aromatic odour somewhat similar to that of valerian, and a sharp, warm, pungent flavour, slightly resembling that of camphor; and they operate on the animal system as stimulants, diaphoretics, and tonics. The roots of the three-lobed and the sweet-scented species are used as stomachics by the black population of Jamaica. The roots of the common species possess similar properties to

those of the snake-root species, and have been used, in various parts of Europe, for indigestion, fistula, sarcoma, and other diseases. The roots of the small species, which grow on dry stony grounds in Provence and Languedoc, have been used for the same disorders as the common species, and for obstructed perspiration and diseases of the lungs. The roots and other parts of the long, the round, the bracteated, and the Indian species, are used for various medicinal and economical purposes by the natives of the East Indies. Several of the species are very highly ornamental, and have long been in great favour with amateur gardeners. The three-lobed species, till a few years ago, was always treated in Great Britain as a stove plant; but it has recently become so far acclimated as to grow in favourable situations upon an open south wall; and it is there found to be exquisitely ornate, in at once its flowers, its large, dark, glossy foliage, the long tail-like appendages of its leaves, and the convolutions and pependencies of its peculiar mode of growth.—*Miller's Gardener's Dictionary*,—*Loudon's Encyc. of Plants*.—*Duncan's Dispensatory*.—*Loudon's Gardener's Magazine*.—*Ainslie's Materia Medica of Hindostan*.

ARM. The upper division of the foreleg of a horse. It extends from the lower bone of the shoulder to the knee, and, though strictly one bone in an old horse, consists of two bones in a young horse. The front and larger bone of the arm is nearly straight, and technically bears the name of *radius*; the hinder and shorter bone has a comparatively long and powerful projection, and technically bears the name of *ulna*; and these are connected by cartilage and ligament, which eventually become ossified so as to render the two bones one. Good judges of horses, though differing in opinion as to various points about the arm, are agreed that this important member of the animal ought to be large and muscular,—that every thoroughbred horse has a full and swelling arm,—and that a horse whose arm is narrow in front, flat on the side, and deficient in play and power of muscle, can neither raise his knee for rapid action, nor throw his legs sufficiently forward for the purposes of either gracefulness, agility, or strength.

ARMATURE. The parts of vegetable organization which seem to have been designed for defence against the attacks of animals. The most frequent and distinguished elements of armature are thorns, prickles, spines, and stings.

ARMENIACA. See **APRICOT**.

ARMERIA. See **THRIFT**.

ARNATTO. See **ANNATTO**.

ARNICA. A genus of hardy, perennial, herbaceous plants, of the composite family. Five species are cultivated as ornamental plants in the gardens of Great Britain; one of these five is in extensive use and high fame as a medicinal plant; and about thirty other species are known to botanists. Three of the introduced species

are natives of Austria, grow to the height of respectively 6, 12, and 18 inches, and bloom in July and August,—one of these producing a white flower, and the other two yellow flowers. Another of the introduced species, *Arnica glaciaria*, is a native of Switzerland, grows about a foot high, and produces a yellow flower from June till August. The fifth of our species, the chief and medicinal one, *Arnica montana*, is a native of the Alps, the German mountains, and other cold parts of Europe, grows to the height of about a foot, and produces yellow flowers in July and August. The powder of it provokes sneezing in the same manner as tobacco snuff; and, on that account, it is called *tabac* in the Vosges. The whole plant, when used medicinally, is diuretic, antiseptic, and strengthening, and removes sensations of soreness, stiffness, and pain, occasioned by blows and bruises; and the powdered root is applied externally in cases of gangrene and bad ulcers, and used internally in cases of dysentery, diarrhoea, quartan fever, asthenia, rheumatism, bruises, gutta serena, and paralysis of the bladder. The comminuted preparation of *Arnica montana* makes a prominent figure in homœopathy.

AROIDEÆ. A large natural order of plants, allied to the sedges and the grasses. It comprises the genera *pothos*, *acorus*, *orontium*, *tacca*, *arum*, *caladium*, *dracontium*, *calla*, *Roxburghia*, *aspidistra*, and *tupistra*, constituting the tribe *Genuinæ*; the genera *typha* and *sparganium*, constituting the tribe *Typhineæ*; the genus *lemna*, constituting the tribe *Pistiaceæ*; and the genera *leptanthus*, *aponogeton*, *Scheuchzeria*, *potamogeton*, and *triglochin*, constituting the genus *Juncaginæ*. The plants of this extensive division are on the frontiers of the endogenous portion of the vegetable kingdom, and, in structure and character, approach very nearly to exogens; they present a medium appearance between sedges or grasses, and fleshy or succulent herbs; and they have broad fleshy leaves, and are stemless, herbaceous, and coalescent. The *Typhineæ* or bulrushes closely resemble the sedges in habit; the *pistiaceæ* are floating plants, with flowers of the most rudimental character; the *Juncaginæ* are obscure marsh or river plants; but the *Genuinæ*, or main and proper body of the *Aroideæ*, are prominent, bold, fleshy plants, and often climb, by their rooting stems, to the tops of lofty trees. Some are natives of Europe, but most inhabit the tropics. Their thick fleshy roots, when fresh, contain an acrid stimulating principle; but, when cooked or otherwise much heated, they lose that principle, and, in various instances, become common articles of food. The flowers of many are highly fetid; the leaves and roots of several are variously medicinal; and the entire plants of some, particularly in the genera *calla*, *arum*, and *Roxburghia*, are cultivated for ornament.

AROMA. The odorous part of plants. An emanation, frequently imponderable, from bodies which acts on the organ of smell, and varies with

the body exhaling it. Boerhaave attributed odorous emanations to a subtile fluid, which he regarded as capable of exciting great influence on the phenomena of vegetation and the animal economy, and which he named *Spiritus rector*,—an expression which was afterwards changed for that of *aroma*. Macquer agreed with Boerhaave in this notion; but admitted that the effluvia was generally composed of an oil and a subtile acid. Fourcroy opposed this idea, and contended that all odours are produced by the simple solution of the odorous substance in the air, or in a fluid; he admitted that each substance has its particular odour; that the compounds which contain a volatile principle owe their particular odour to it; and that the aroma of aromatic plants resided solely in their essential oils. But to this it has been objected, that there are some bodies, such as musk, which are not sensibly volatile, and which yet spread a strong odour; while there are essential oils, the solution of which in water are not at all like the aroma of the part of the vegetable which has yielded them, and a number of odorous flowers are destitute of essential oil. Hence M. Robiquet is of opinion that the odours which diffuse themselves in the air ought not to be generally attributed to a simple volatilization, or emanation, produced by the odorous body itself; but, in many cases, to a gas, or vapour, resulting from its combination with an appropriate vehicle, capable of diffusing it through the atmosphere.

AROMATIC REED. See ACORUS.

AROMATICS. Plants, gums, essential oils, or other substances, which yield a fine fragrant smell, and have a warm spicy taste. They are very various in both odour and action, ranging from the semi-acridity of ginger-root, capsicum, and some pungent essential oils, to the exquisitely delicate and undistillable aroma of the peach, the strawberry, the coffee bean, and the tea leaf; but, in general, they are combined with either bitter principles, as in the case of hops and the tonic barks and roots, or with gently narcotic principles, as in the case of tea, coffee, mace, and nutmeg,—and they either assist the tonics in gratifying and strengthening the stomach, or co-operate with the narcotics in exerting a softly soothing influence upon the nervous system. All aromatics, though in very various degrees, exert a controlling power over fermentation, in some instances arresting it, and in others modifying the nature of the products which are generated. The volatile oil of mustard and the empyreumatic oils completely arrest the action of yeast; and the oil of hops, or the mere native aroma of hops given out in the ordinary process of brewing, greatly diminishes the influence of decomposing nitrogenous substances, such as wort or malt, upon the conversion of alcohol into acetic acid. Aromatics are very numerous and extensively employed as ingredients in the compound drugs administered to the human subject; but, except-

ing ginger, chamomile, gentian, and juniper, they are little known in cattle medicine.

ARPENT. The French acre, in general use before the establishment of the decimal system; but, like the acre in England, varying in almost every district. The Great arpent, known also as the *arpent d'Ordonnance*, or *arpent des Eaux et Forêts*, contains 100 perches of 22 French square feet, and is equal to 0.5107 of a French hectare, or 6,107 English square yards, or about one acre and three-fourths of a rood of English measure. The Middle arpent, or the *arpent Commun*, contains 100 perches of 20 French square feet, or 0.5221 of a French hectare, or 5,048 English square yards, or 3 roods, 36 perches, and 149 feet of English measure. The Little arpent contains 100 perches of 18½ French square feet, and is equal to 3 roods, 7 perches, and 27 feet of English measure. Of these the *Arpent Commun* was the most universally employed in the provinces.

ARRACACIA. See ARACACHA.

ARREST. A law term,—from the French *arreter*, to stop or stay,—signifying the restraining of a man's person, for the purpose of securing his obedience to the law.

Arrest is considered as the beginning of imprisonment; and it may be made either for a civil debt exceeding £20, or upon a criminal accusation. In the former case, the arrest is made by seizing or touching the defendant's body by the sheriff, or his officer, in consequence of a precept or commandment out of some court. After such seizure, the bailiff may justify breaking open any house in which the debtor is, to take him; otherwise he has not that power, but must watch his opportunity of arresting him: for the law regards every man's house as his castle of defence and asylum, in which he ought not to suffer any violence. But if the bailiff should happen to find an outer door open, he may open the inner door, without being liable to an action of trespass. English writs express arrest by two words, *capias* and *attachias*, to take and catch hold of a man: for it is necessary to constitute a lawful arrest that the officer should actually lay hold of the person, besides saying that he arrests him. If a bailiff, however, touches a man, it is an arrest; and if the person makes his escape, it is a *rescous*, and attachment may be had against him. If a bailiff lays hold of one by the hand held out at a window, this is such a taking of him as will justify his breaking open the house to carry him away. If a bailiff be kept off from making an arrest, he shall have an action of assault; and where the person arrested resists or assaults the bailiff, he may justify beating of him. The officer must, on making the arrest, deliver a copy of the writ to the defendant, and he is not to convey him to gaol until twenty-four hours have expired, unless the prisoner refuses to go with him to some place of safe custody. When arrested, the defendant may obtain his discharge by depositing the amount of the debt sworn to with the sheriff or

his officer, and £10 to answer costs; or by giving bail for his appearance in court. Arrest, which takes place before trial, in civil cases, is known in English law as *arrest on mesne process*; if after trial and judgment, it is called *arrest in execution*, or *on final process*; but by 1° and 2° Vict. cap. 110, no arrest on mesne process can be made before a judgment has been obtained on a writ of summons; and by the statute 7° and 8° Vict. cap. 96, no person shall be taken or charged in execution for the recovery of any debt not exceeding £20, exclusive of costs.

In Scotland, imprisonment of a debtor usually proceeds under what is called *Letters of Horning* directed to messengers-at-arms, in which the debtor is charged to pay or perform within fifteen days under pain of being "put to the horn," or treated as a rebel. But magistrates of royal burghs can order direct execution, or *act of warding*, against a debtor who has resided forty days within their jurisdiction.

Peers of the realm, peers of Scotland, peeresses by birth, peeresses by marriage, not having afterwards intermarried with a commoner, members of parliament, and corporations, are privileged from arrests, and consequently from outlawries: against them, therefore, the process to enforce appearance must be by summons and distress, instead of a *capias*. Clerks, attornies, and all other persons attending the courts of justice, are not liable to be arrested by the ordinary process of the court; but must be sued by bill—usually called a *bill of privilege*—they being presumed to be personally present in court. Suitors, witnesses, and other persons necessarily attending any court of record upon business, are not to be arrested during their actual attendance, which includes the time of their coming and returning. A bankrupt coming to surrender; witnesses properly summoned before commissioners of bankruptcy, or other commissioners under the great seal; heirs, executors, or administrators, except on their own personal contracts, or in cases of *devastavit*, are exempted from arrests. Clergymen performing divine service, and not merely staying in the church with a fraudulent design, are, for the time, privileged from arrests, by stat. 50° Edw. III. cap. 5, and 1° Ric. II. cap. 16; and likewise members of convocations actually attending thereon, by stat. 8° Henry VI. cap. 1. Ambassadors and their domestic servants are not liable to arrests. By stat. 31° Geo. II. cap. 10, no seamen on board his majesty's ships can be arrested for any debt, unless the same be sworn to amount to at least £20; but by the annual mutiny acts, a soldier may be arrested for a debt of half that value, but not to a less amount. In an action against husband and wife, the husband alone is liable to be arrested. No person may be arrested in the king's presence; nor within the bounds of his royal palace; nor in any place where the king's justices are actually sitting. Besides, the king hath a special prerogative

—which, however, is very rarely exercised—by virtue of which he may grant a writ of protection, to privilege a defendant from all personal and many real suits, for one year at a time, and no longer; in respect of such person being engaged in his service abroad. By the stat. 29° Car. II. cap. 7, no arrest can be made, nor process served upon a Sunday, except for treason, felony, or breach of the peace.

Arrest, in criminal cases, is defined to be, the apprehending or restraining one's person, in order that he may be forthcoming to answer an alleged or suspected crime. To this species of arrest all persons whatsoever are liable without distinction; but no one may be arrested, unless charged with such a crime as will at least justify holding him to bail. Arrest, in criminal cases, may be made in four ways.

1. By warrant, which may be granted, in extraordinary cases, by the privy council, or the secretaries of state; but ordinarily by justices of the peace. In the latter case, the warrant should be under the hand and seal of the justice, setting forth the time and place of making, and the cause for which it is made; and it should be directed to the constable, or other peace officer, requiring him to bring the party either generally before any justice of the peace for the county, or only before the justice who granted it; the warrant in the latter case being called a *special warrant*. *General warrants* to apprehend all persons suspected, without specially naming or describing an individual, are void and illegal. When the officer receives a warrant, he is bound to execute it, so far as the jurisdiction of the magistrate and himself extends. A warrant from the chief, or other justice of the King's bench, extends all over the kingdom: but the warrant of a justice of the peace in one county must be backed or countersigned by a justice of the peace in another, before it can be executed there. This practice of backing warrants had long prevailed without law, but was at length sanctioned by the statutes 23° Geo. II. cap. 26, and 24° Geo. II. cap. 55. In criminal cases, an officer may break open doors, or use any degree of force that may be necessary to execute his warrant. Magistrates may grant warrant to arrest parties who are charged with offences over which they have themselves no jurisdiction: thus a sheriff may commit for treason, or the magistrate of a burgh for murder, or upon pleas of the Crown.

2. Arrests may be executed without warrant by a justice of the peace, by the sheriff, the coroner, the constable, by watchmen, and by policemen; or by any private individual specially invested *pro hoc vice* with the powers and privileges necessary for such execution.

3. All private persons who happen to be present when a felony is committed, are bound by the law to arrest the felon, on pain of fine and imprisonment, if he escapes through their negligence. They will be justified even in breaking

open doors, and in using force to secure the felon, if they actually saw the offence committed. Any person may apprehend for offences against the Vagrant act, 4^o and 5^o Geo. IV. cap. 83, or against the Larceny, act 7^o Geo. IV. cap. 29, and the Malicious injuries act, 8^o Geo. IV. cap. 30. A private person may also arrest upon suspicion; but this is barely permitted, and not enjoined by the law; and therefore he cannot justify breaking open doors to do it; and if either party kill the other in the attempt, it amounts to manslaughter.

4. The fourth mode of arrest is by *hue and cry*—*hutesium et clamor*—raised upon the commission of a felony. This is the old common law process of pursuing, with horn and with voice, all felons, and such as have dangerously wounded another. For an account of its origin and effects, see HUE AND CRY.

ARRESTMENT. A term in the law of Scotland applied either to persons or to things.

In the former case, it may denote the securing of a criminal, until he undergo trial, or give bail. In certain special cases, a judge may arrest or secure the persons of such as have neither domicile nor estate within his territory, even for civil debts. Thus, on the border between Scotland and England, warrants are granted of course by the judge ordinary of either side, against debtors who have their residence on the opposite side, for arresting, not only their effects, but their persons also, until they give security *judicio sisti*. Even the persons of citizens or natives may be so secured, where there is good reason for suspecting that they are *in meditatione fugæ*, i. e. that they mean to withdraw themselves from the kingdom, and so disappoint their creditors. This suspicion the creditor applying for the warrant must declare upon oath; but he will be liable in damages, should the circumstances, which he offers to prove in support of his suspicion, appear insufficient to justify the imprisonment.

An inhabitant of a borough-royal, who has furnished one who lives without the borough with meat, clothes, or other merchandise, having no security for the debt but his own compt-book, may arrest his debtor, until he give security *judicio sisti*, in consequence of a special privilege conferred upon boroughs-royal, by the act 1672, c. 8. But this arrestment shall not be allowed to an assignee, nor in cases where security has been taken for payment of the debts.

Arrestment, when applied to things, is a mode of diligence by which a creditor may attach the moveable estate of his debtor; or, it is the order of a judge, by which he who is debtor in a moveable obligation to the arrester's debtor is prohibited to make payment or delivery, until the debt due to the arrester be paid or secured. The arrester's debtor is usually called the *common debtor*; because, where there are two or more competing creditors, he is debtor to all of them. The person in whose hands the diligence is used, is styled the *arrestee*.

Arrestment may be laid on by authority, either of the supreme court, or of an inferior judge. In the former case, it proceeds, either upon special letters of arrestment, in the king's name, passing the signet, and prepared by a writer to the signet, or upon a warrant contained in letters of horning; and it must be executed by a messenger-at-arms. Warrants granted by inferior judges are called *precepts of arrestment*, and are executed by the officer of the court.

All debts containing a personal obligation, even although heritably secured, are grounds for arresting the moveable estate of the debtor; and arrestment may even proceed upon a debt, of which the term of payment is not yet come, in cases where the debtor is *vergens ad inopiam*. Arrestment may likewise proceed upon a depending action, when the creditor executes a summons against his debtor, for payment of a debt not yet constituted by decree or registration. Moveable debts constitute the proper subject of arrestment; and all bonds, which have not been made properly heritable by seisin, are declared arrestable by 1644, c. 41, revived by 1661, c. 51. But there are certain moveable debts which are not subject to arrestment. 1. Debts due by bill. 2. Future debts. Hence an arrestment of rents or interests carries only those that have already fallen due, or at least become current at the time of arrestment. 3. Alimentary debts; among which are included the salaries granted by the crown, and the fees of servants, in so far as they amount to a reasonable allowance for the maintenance of the person who fills the office. But this rule is subject to some modifications; for ministers' stipends and other salaries have been found to be arrestable.

When the arrestee is a pupil, the arrestment must be used in the hands of his tutor; if past pupillarity, it may be used either in his own hands, or in the hands of his curators. If the debtor have executed a trust, the arrestment may be used in the hands of his trustees. If the debtor be a company, the arrestment must be used in the hands of the partners at their counting-house or ware-room, or at their respective dwelling-houses. When arrestment is to be used in the hands of a corporation, it must be done either at a regular meeting, or in the hands of the treasurer, or other officer, in whose name the corporation is appointed to sue and be sued. If the debtor be abroad, the arrestment must be executed edictally at the market-cross of Edinburgh, and pier and shore of Leith; and it must be intimated to his agent in this country. 33^o Geo. III. c. 74, sec. 4.

If the arrestee shall pay the sum, or deliver the goods arrested to the common debtor, he is not only liable to a criminal prosecution, for breach of arrestment; but he must likewise pay the debt again to the arrester. And in the case of arrestment executed at the market-cross of Edinburgh; and pier and shore of Leith, against

a person abroad upon the public service, payment made by the arrestee, after the date of the arrestment, makes him liable in second payment to the arrester.

Arrestment on a depending action may be loosed by the common debtor's giving security to the arrester for his debt, in the event that it shall be found due. Arrestment on decrees, or on registered obligations, can only be loosed on payment or consignment; excepting; 1. Where the term of payment is not yet come, or the condition has not yet existed. 2. Where the arrestment has proceeded on a registered contract, in which the mutual obligations are not liquid. 3. Where the decree is suspended, or turned into a libel.

The competition between arrestments is governed by their respective dates, according to the priority, even of hours, when it can be ascertained with any degree of certainty. All arrestments, however, used within 60 days preceding the period of bankruptcy, or within four calendar months thereafter, are preferred *pari passu*, as if they had been used of the same date. The competition of arrestments with assignments is also regulated by their priority. If the assignment be intimated before arrestment, the assignment is preferred; but if not intimated till after, though granted before the arrestment, the arrestment is preferable. If the intimation and arrestment are of equal date, they are preferred *pari passu*.

Arrestment is considered merely as a begun diligence, and it must be perfected by an action of *furthercoming*. And arrestments are lost by the lapse of three years from the date of execution, if in execution, or, if in security, of three years from the day the debt becomes due, if no step be taken to make the arrested effects furthercoming. —See *Erskine's Institutes*, b. iii. t. vi.—*Bell's Dictionary of the Law of Scotland*, v. ARRESTMENT.

ARROW-GRASS,—botanically *Triglochin*. A genus of perennial herbaceous plants, of the alisma tribe. They derive both their popular and their botanical name from having triangular, three-celled capsules; and all are aquatics, and grow to the height of about a foot. The marsh species, *Triglochin palustre*, grows indigenously in the watery meadows of Great Britain, and produces a green flower in July and August; the sea species, *Triglochin maritimum*, grows indigenously in the salt marshes of Britain, and produces a green flower from May till August; and both of these species are greedily eaten by cattle, and form both a healthful and a seasonable herbage in the early part of spring. The bulbous-rooted species, *Triglochin bulbosum*, is a greenhouse plant, produces a puce flower in October, and was brought from the Cape of Good Hope in 1806.

ARROW-HEAD,—botanically *Sagittaria*. A genus of perennial aquatic plants, of the alisma tribe. They derive both their popular and their botanical name from the arrow-headed form of their leaves. Six species grow in Great Britain, producing white flowers, and having a height of from

1½ to 2 feet; and ten other species are known to botanists. The common species, *Sagittaria sagittifolia*, grows indigenously in the rivers and standing waters of England, Siberia, Japan, China, and Virginia, and is one of the most handsome of our native aquatics. Its root consists of a nearly globular tuber, with many strong fibres, and strikes deep into the mud; the footstalks of the leaves are round, thick, fungous, and proportional in length to the depth of the water, so that they are, in some instances, nearly a yard long; the leaves float on the water, and are shaped like the head of an arrow, the two ears at their base being very sharply pointed, and spreading widely asunder; and the flowers have each three broad, white, spreading petals, and a cluster of stamina with purple summits, and are produced upon long stalks, which rise above the leaves, and stand in whorls round them at the joints. The root of this species is extensively cultivated for food in China, but grows to a larger size in that country than in Britain.—The brittle-leaved species, *Sagittaria rigida*, is hardy, and was introduced from North America in 1806. The other four species grown in Britain are tender plants, and natives of China, Carolina, and the West Indies.

ARROW-ROOT. A kind of starch manufactured from the roots of a plant, the *Maranta arundinacea*, which is cultivated in the West Indies. It is about two feet in height; has broad, pointed, and somewhat hairy leaves; bears small, white flowers in clusters, and globular fruit of the size of currants. The starch or powder of the arrow-root is obtained by the following process:—The roots are dug when a year old, and well washed, and beaten in deep wooden mortars till they are reduced to a milky pulp. This is well washed again in clear water, and the fibrous parts, which are found among it, are carefully separated, and thrown away. It is next passed through a sieve or coarse cloth, and suffered to stand for some time, till the starch has settled to the bottom. The water is then drawn off, and the white residue is again washed; after which the water is entirely drained off, and the pulp, when dried in the sun, is found to be an extremely pure starch, which, when reduced to powder, is the arrow-root of commerce.

Benzon's analysis of the root gives:

Volatile oil,	.	.	.	0.07
Starch,	.	.	.	26.00
Albumen,	.	.	.	1.58
Gummy extract,	.	.	.	0.50
Chloride of calcium,	.	.	.	0.25
Insoluble fibre,	.	.	.	6.00
Water,	.	.	.	65.60
				100.00

There is no vegetable, if we except, perhaps, the salep or orchis root, which yields so large a proportion of nutritious mucilage as this. As an article of diet for children and invalids, it is invaluable, more especially in all forms of bowel complaints. Owing to the great demand for it,

it has been much adulterated, and care is required in the selection of it. The purest is the Jamaica or Bermuda arrow-root. A very cheap and tolerable substitute for this article may be found in the starch obtained from the potato (see POTATO), which cannot be too highly recommended. When carefully prepared, it is equally agreeable, and probably as nutritious as Bermuda arrow-root. West Indian arrow-root is often counterfeited by the substitution of an East Indian variety prepared from the tubers of the Narrow-leaved turmeric, which does not make so fine a jelly with boiling water as the West Indian variety. When compared with the latter, the East Indian arrow-root has a less crepitating feel, and is composed of larger granules. An article, introduced not long ago under the name of 'Tous-les-mois,' is the fecula of the *Canna coccinea*. It has a slightly satiny appearance, and makes a stiffer jelly than the arrow-root.

ARSENIC. A metal of very common occurrence, being found in combination with nearly all of the metals in their native ores. It is of a bluish-white colour, readily becoming tarnished on exposure to air, first changing to yellow, and finally to black. In hardness, it equals copper, is extremely brittle, and is the most volatile of all metals, beginning to sublime before it melts. Its specific gravity is 5.736. It burns with a blue flame and a white smoke, emitting a strong smell of garlic. It commonly bears the name of *black arsenic*, and is prepared from the white arsenic of commerce, by heating this substance with carbonaceous matter, and allowing the volatile arsenic to condense in an adjoining vessel. Arsenical pyrite, a very abundant natural substance, is also advantageously used in the preparation of arsenic, in which case iron filings and lime are added, to engage the sulphur, and prevent its sublimation along with the arsenic. Native arsenic has been found in the veins of primitive rocks in several countries, but in small quantities, and generally alloyed by the presence of iron, silver, or gold. This metal is used in metallic combinations, when a white colour is desired. With oxygen, arsenic forms two compounds, both of which, from their property of combining with alkaline and earthy bases, are called *acids*. The arsenous acid, the most important of the two, is the *white arsenic* of the shops. It is usually seen in white, glassy, translucent masses, to which form it is reduced by fusion from a powdery state. It is one of the most virulent poisons known, not only when taken into the stomach, but when applied to a wound, or even when its vapour is inspired. It is found native in small quantities, but is obtained for use from the roasting of several ores, particularly from that of cobalt and arsenical pyrites. The arsenous acid is condensed in long, horizontal chimneys, leading from the furnaces where these operations are conducted, and usually requires a second sublimation, with the addition of a little potash, to deprive it of any sulphur it may con-

tain. Its manufacture has been chiefly confined to Bohemia and Hungary. Persons brought up from their youth in the works live not longer than to the age of 30 or 35 years. Knowing the deleterious nature of their occupation, they are so careless, that we have seen them cleaning their plates, &c., in wells, over which a skull was painted, to warn every body that the water contained arsenic. Besides its use in medicine, and as a rat-bane, it is much employed as a cheap and powerful flux for glass; but when too much is added, it is apt to render the glass opaque, and unsafe for domestic use. Arsenite of potash, mingled with sulphate of copper, affords an apple-green precipitate, called *Scheele's green*, which, when dried and levigated, forms a beautiful pigment. With sulphur, arsenic forms likewise two definite compounds—the realgar and orpiment. The former of these contains the smallest proportion of sulphur, and is red; the latter is yellow. They are both found native in many countries, but their supply in commerce depends upon their artificial manufacture. This is done by distilling a mixture of arsenical pyrites and iron pyrites, or of white arsenic and rough brimstone. Realgar or orpiment is obtained as the proportion of sulphur employed is greater or less. These compounds afford valuable pigments to the painter.

The various preparations of arsenic are possessed of eutrophic or alterative virtues, and when continued for a proper length of time, and under judicious management, so alter the functions of nutrition as to remove diseased actions. In chronic cutaneous diseases, for example, arsenic has been found a most valuable agent. The arsenical paste sometimes employed in cases of cancer is composed of 70 parts cinnabar, 22 dragon's blood, and 8 arsenious acid. In veterinary practice, it has been given in glanders and in farcy, but with no markedly beneficial results, and a small quantity has not unfrequently produced fatal inflammation of the stomach. The antidote to an overdose of arsenic is to drink plentifully of cold lime-water, and after that use an emetic of sulphate of zinc, to be followed by a copious dose of castor oil, or large draughts of milk.

ARTEMISIA. See WORMWOOD.

ARTERIES. That order of vessels which arise from the two ventricles of the heart, and have valves only at their origin; their use being to carry the blood from the heart to the various parts of the system. When the blood leaves the heart, it is sent with considerable force into the large trunks of the arteries; these vessels soon begin to ramify in various directions to all parts of the body, until at length they are reduced to vessels too small to be traced by the eye, or even by the microscope. There are in the body two distinct sets of arteries, which are distributed to different organs, and serve very different purposes in the animal economy; one of these is sent to the lungs, the other to all the remaining parts

of the body; the former constitutes the *pulmonic*, the latter the *systemic circulation*. Before the blood can be employed in the various functions of the body, it is necessary for it to undergo a certain change, which is effected in the lungs. After it has undergone this change, it is brought back to the heart, and is again propelled from this organ, along the arteries of the systemic circulation, to all parts of the body. The arteries which perform this office of conveying the blood from the heart, are flexible elastic tubes, principally composed of membrane, but—as is generally supposed—containing also a quantity of muscular fibres, which give them, to a certain extent, the power of contracting, and consequently of propelling their contents.

ARTESIAN WELL. A flow of water to the surface of the earth, from strata situated beneath the lowest subsoil, through a perpendicular boring made with a long auger and rod. It is called artesian from the supposition, that the art of making it was first known and practised in the district of Artois in France; yet it appears to have been known in Italy at a very ancient period, and it belongs, in modern times, fully more to the United States of America than to the old world. The artesian well is of great value on farms and in districts in which a summer supply of good water is scarce; and it has, within a recent period, refreshed and enriched many a spot whose soil was comparatively infertile with aridity, and whose inhabitants suffered unhappiness and disease from thirst or from noxious water. Some artesian wells have been bored to the depth of 2,000 feet before a plentiful and permanent flow of good water has been obtained; and many, at both great depths and small, have brought up in arid districts such copious supplies as have provoked the astonishment of all unscientific observers.

The Abattoir de Grenelle in Paris being at too high a level to obtain an adequate supply of water by the ordinary means, it was proposed to sink an artesian well within the premises, which proposal having been agreed to, the work was perseveringly carried forward through many difficulties during eight years, until the boring was terminated by the auger penetrating the water-bearing strata on the 26th February, 1841, when a sudden and violent rush of water occurred, overflowing at the surface of the ground. As the boring progressed, tubes of rolled iron, and subsequently of copper, were inserted to support the sides; the first being $12\frac{1}{4}$ inches diameter, and the lowest about $6\frac{1}{2}$ inches diameter, reaching to a depth of $1,794\frac{1}{2}$ English feet. The quantity of water thrown up while the bore remained in this state was about 880,000 imperial gallons per day, at a temperature of $82\frac{1}{2}^{\circ}$ Fahrenheit. At a recent meeting of the Paris Academy of Sciences, a letter was read from M. de Humboldt, on the boring for an artesian well in Westphalia. It is intended, he says, to bore to a depth of 2,000 metres, about a mile and a quarter English, and

at that depth it is supposed that the water will be of the great heat of 70° centigrade. The borers had reached to a depth of 622 metres. To that depth the increase of temperature had not followed the ordinary law, which, according to M. de Humboldt, resulted from the cooling of the column of atmospheric air by the waters of filtration from above; but having arrived at 622 metres, the ascensional force was sufficiently great to force back the water from above, and the ordinary law was re-established. M. Arago announced that it was the intention of the French government to form an artesian well in the Jardin des Plantes. It is intended to be 900 metres, that is, 200 metres deeper than the Grenelle, and a temperature of 31° centigrade is anticipated. The water will be employed to heat the hot-houses of the gardens, and to supply the hospitals of La Pitié and La Salpetriere.

The principle of these wells is exactly that of natural springs or fountains; and is very closely exemplified in the ascent of water through a fault or fissure or natural orifice in the strata of a slanting, hilly mass of rock. Water absorbed into the ground from the surface of a hill or superior piece of plain, descends till it meets an impervious stratum; it then flows slowly through the portion of porous strata immediately incumbent on the impervious bed, following the dip or inclination of that bed, and proceeding, in some instances, for miles before finding an outlet; and whenever it arrives at an orifice, whether natural or artificial, it ascends to any level not greater than that from which it has descended. In most of the terrestrial parts of the world, therefore, streams of water, of greater or less volume, are flowing beneath the surface, to well up in the myriads of springs which constitute the sources of rills and rivers; and wherever an artificial boring can be so made as to connect any of these substrata streams with a spot on the earth's surface not higher than the spots at which their waters entered, an artesian well will be formed. But in some cases the stream is so small, and in others it flows at so enormous a depth, that a tolerably good geological knowledge of a district is requisite for determining when an attempt to form an artesian well is likely to be cheap and successful, or when it is likely to be either very costly or altogether vain. At the Plymouth meeting of the British Association, Professor Sedgwick, after reviewing the general principle of artesian wells, noticed two districts, in the one of which attempts to form the wells are eminently successful, and in the other totally ineffective. "In the eastern part of Essex, the chalk is covered by sandy beds of the plastic clay, and these by several hundred feet of impervious strata of London clay, all dipping together towards the east. The arenaceous beds below the London clay rise higher towards the chalk than the clay does, and absorb a considerable part of the water from the high grounds. By boring through the clays

to this sand, springs of water immediately rise above the surface, and are carried off by natural channels. By this supply of water, the value of the land has been materially increased, since the country, though abounding in peat-bogs and stagnant ponds during winter, suffers much from the summer drought. The district of opposite character, in which all attempts to form artesian wells are failures, is that near Lincoln, which, though surrounded by fens covered with water in the winter, is not sufficiently supplied during the summer. But the clays supporting the fens of the Bedford Level are below the chalk; and though there are pervious beds beneath them, which rise to the north-west, yet the clays are of such enormous thickness that they have never been penetrated; and even were that accomplished, the high land is so distant that intervening fissures, filled up with impervious materials, might intercept the supply. Expensive sinkings have been made at Lynn, and also at Boston; but, after boring through many hundred feet of clay, they have utterly failed; and, in any future operations in this district, the chance of success would be very remote."—[*Edinburgh Philosophical Journal.*]

ARTICHOKE,—botanically *Cynara*. A genus of perennial herbaceous plants, of the thistle division of the composite family. Seven species have been introduced to Great Britain; and three other species are known to botanists. The garden species, *Cynara scolymus*, was introduced to Great Britain from the south of Europe, and is everywhere known in Great Britain as a garden esculent. The cardoon, *Cynara carthulinus*, was introduced from Canada in 1658; and is also well known as a garden plant. See **CARDOON**. The Madeira species, *Cynara horrida*, was introduced from Madeira in 1778, is a tender herbaceous evergreen, grows to the height of six feet, and flowers in August and September. The Cape species, *Cynara glomerata*, is also a tender herbaceous evergreen, was introduced from the Cape of Good Hope in 1816, grows to the height of two feet, and flowers in July and August. The dwarf species, *Cynara humilis*, was introduced from Spain in 1613, grows to the height of 18 inches, and flowers in July and August. The stemless and the pigmy species, *acaulis* and *pygmaea*, grow to the height of one foot, flower in July, and are natives of respectively Barbary and Spain.

The garden artichoke was cultivated by the ancients, for the sake of both its root and its fructification. Artichokes are stated by Pliny to have been preserved in vinegar and in honey, seasoned with the root of laserwort and cumin, and so made fit for use at any season of the year. Not only did the ancients eat the root and the flower of the plant, but they expressed the juice previous to the time of blossoming, and used it for the attempted restoration of the hair on bald parts of the human head. The artichoke seems to have been procured by the Greeks and the

Romans from Sicily and from the neighbourhood of Carthage; but during the middle ages, it appears to have gone out of cultivation; and, in modern times, it is said to have been first seen in the Venice gardens, in 1473, being then very scarce, and having but a few years previously become an object of cultivation in other parts of Italy. In the beginning of the 16th century it was introduced into France, and in 1548 into Great Britain; and after it began to be cultivated in our gardens, it improved so much in size and flavour that the Italians sent to this country for plants.

The artichoke is so closely allied to the thistle in general appearance, as well as in its botanical characters, as to be rather a repugnant looking esculent to persons who have never used it. It grows to the height of 8 feet, has undivided and somewhat spiny pinnate leaves, and produces a bluish-purple coloured flower in August and September. Its order of flowering is imbricated; its flower is contained in a dense close head; and its seeds are surmounted by a feathery down or pappus. The head containing the flower and its bristly appendages is the only part of the plant eaten in England; and this consists of a fleshy receptacle, and of an alternating series of scaly bractees or floral leaves, which are furnished with a pulpy substance at and above their point of union with the base. But there are two varieties of the plant,—the globe and the French. The globe variety has broad, brown, inward-turned scales; and its fleshy receptacle, the most valuable part for use, is comparatively very thick. The stalks of the French variety are generally taller than those of the globe variety; the heads are smaller in size, and more conical in shape; the scales are narrower and greener, and turn outward; and the fleshy receptacle is comparatively thin, and has a disagreeable perfumed flavour. The French variety has, in peculiar emergencies, been pretty extensively cultivated; but the globe variety is in far more general esteem, and possesses a much superior degree of intrinsic value. A subvariety of the globe is dwarfish and very prolific.

The artichoke delights in a rich light soil, and will find itself well accommodated in a thoroughly pulverized sandy sward, such as may be pared from ordinary sheep pasture-land with a sandy soil. Suckers or offsets taken from old plants ought to be planted in March or April, either in a bed of three rows, four or five feet asunder, or in single rows between other vegetables. The soil ought to be previously laid quite smooth or level; and the planting-line being drawn very tight, each sucker or offset ought to be planted with the dibble or garden trowel, and fixed securely in the soil. The firm fixation of the base and lower parts of the sucker in recently moved ground, stimulates the vital principle of the sucker, occasions it to be acted upon by the electro-gaseous products of the soil in the very

process of their evolution, and very effectively promotes its growth. Should the soil and the weather be dry at the time of planting, water ought to be freely poured around the suckers in several successive doses, to fix them in the soil, and to prevent stagnation of the vital fluids. As the plants grow up, the ground must be kept clean and moderately open; and at the approach of frosty weather, the soil must be drawn about the stems, as in landing up celery, but not brought to so sharp a ridge. Though some of the plants will not be prolific, any crop as a whole will produce an abundant harvest in the autumn of the same year in which it is planted; yet the grand care of the cultivator ought to be the healthful preservation of the plants during winter, and their subsequent judicious cultivation with a view to future harvests. In the first season, the fruit ought to be gathered, and all the stems cut close; and as a powerful auxiliary to the effects of earthing up, wreaths of dry litter may be placed round the stumps of the stems or crowns of the roots, and the soil so drawn upon these as to cause rains to glide easily into the furrows. In the second season, the plants, if properly managed, will become very abundantly prolific; and at the approach of severe frost, they ought to be carefully protected with straw, haulm, or evergreen boughs, so placed upon the ridges as to form a sort of roof over the herbage; yet in rainy weather, these coverings ought to be removed. The heads or esculent parts of the plants may be preserved throughout the winter and early spring months, by setting the lower ends of the stems in sand, under shelter of an out-house or cool dry cellar. The suckers, whence new plants may be raised, are profusely produced by all healthy old plants, and ought to be detached, not in the torpid season, but in the month of March. "We suggest, on the ground of the doctrine of radical excretion," says Mr. Towers, "that if the plants stand in single rows widely apart, between which a rank of potatoes, beans, or peas, be grown, the new suckers be planted on the site of such crops, in order to reap the benefit to be derived from the matters ejected into the soil by their excretory organs, and by the actual deposition of detached vegetable fibres. Thus artichokes and annual crops may be made every two or three seasons, to alternate or rotate with each other."

Sometimes the tender central leafstalk of the artichoke is used in a blanched state like the cardoon; and in this case, the plants must be cut away by the surface about mid-summer,—they will produce leaves about two feet in height toward the middle of September,—they must then be closely bound with a wreath of hay or straw, and covered round with soil,—and they will complete their blanching, and become ready for use, in the course of four or six weeks.—The artichoke plant dyes a good yellow colour, acts like rennet in curdling milk, and operates medicinally as an aperient and a stomachic.—*Paper by Mr. Towers*

in Quar. Journal of Agriculture.—Maure's Gardener's Calendar.—The Mag. of Domestic Economy.—London's Encyc. of Plants.—Miller's Gardener's Dictionary.—British Husbandry.

ARTICHOKE (JERUSALEM),—botanically *Helianthus tuberosus*. A perennial, tuberous, esculent-rooted, herbaceous plant, of the composite family. It is called artichoke from a resemblance in the flavour of its tubers to that of the edible heads of the true artichoke; and it bears the absurd epithet Jerusalem from an ignorant corruption of its Italian name *girasole*. It is a native of Brazil, and was introduced to Great Britain in 1617. It grows to the height of from 5 to 10 feet, has three-nerved scabrous leaves, and produces a yellow flower in September and October. Though the native of a warm country, it is one of the hardiest of our cultivated plants; and it is easily propagated and very productive, and grows on the poorest soils. It was highly esteemed by our ancestors for its tubers; and, though inferior in flavour and other qualities to the potato, it scarcely deserves the general disrepute into which that more esteemed esculent root has thrown it, but merits considerable attention, and would well repay somewhat extensive cultivation. It grows under shade; it can be cultivated in woods and half-waste grounds; it is sometimes planted in English woods, and left to propagate itself, in order to afford shelter to game; and it might very advantageously be raised on semi-barren or exhausted soils as food for stock. It does not ripen its seeds in Great Britain, yet is very facily propagated from its tubers, in precisely the same manner as potatoes. Either entire small tubers or eyed sets of large tubers may be planted in drills, at wider distances between both rows and plants than in the case of potatoes; and if planted in spring, they will be ready for use in September: yet they may be planted also in autumn. Most English cultivators cut the stems over in July, to prevent them from falling down. In Alsace, Jerusalem artichokes are always grown, without any rotation, and with manure only every second year, upon the same land. At Bechelbroun, upon somewhat shallow soil, they produce per acre 10 tons of tubers and $11\frac{1}{2}$ cwts. of dried stems; and in many situations, upon land of medium quality, and without any manure, they produce per acre about 500 bushels of tubers. The leaves and stems are used on the continent as both green and dry fodder; but only the tubers, so far as we know, have hitherto been used in Scotland. The plant, when growing, is very unsightly, and, when once in full possession of a spot of ground, cannot easily be exterminated, but is apt to overrun every plant in its vicinity; and, for these reasons, it ought not to be introduced to a garden or to any choice piece of field-ground. The tubers are more watery and less agreeable than potatoes, and frequently have the effect of raising much flatulence; yet, though not fattening, they are eagerly eaten by most grani-

verous animals, and constitute decidedly good food for farm stock; and they even form a delicate esculent for man, when they are served, in a boiled condition, in white sauce. A tuber which was analyzed by M. Boussingault weighed, when fresh from the ground, 1 oz. and 15·6 dwts., and, after being dried in the stove 0·7 dwt. One part or integer of this tuber was reduced, after absolute desiccation, to 0·208; one part of the dry tuber was reduced, by incineration, to 0·0594; and its constitutional elements were ascertained to be 43·02 per cent. of carbon, 5·91 of hydrogen, 43·56 of oxygen, 1·57 of azote, and 5·94 of ashes or earthy and saline ingredients. One part or integer of dried stem—which consisted almost wholly of pith, and had stood through the winter where it grew—was reduced by desiccation to 0·871; one part of this left of ashes 0·0276; and its constitutional elements were ascertained to be 45·66 per cent. of carbon, 5·43 of hydrogen, 45·72 of oxygen, 0·43 of azote, and 2·76 of ashes. The tuber of the Jerusalem artichoke is not very much more watery than the potatoe, and it is exceedingly less so than the turnip. The proportion of dry matter in the Jerusalem artichoke tuber is 0·208, in the potatoe 0·241, and in the turnip 0·075; and the proportion of water in the Jerusalem artichoke tuber is 0·792, in the potatoe 0·759, and in the turnip 0·925.—*Boussingault's Rural Economy*.—*Low's Elements of Practical Agriculture*.—*Miller's Gardener's Dictionary*.—*Mauve's Gardener's Calendar*.—*British Husbandry*.—*Loudon*.

ARTIFICIAL GRASSES. See GRASSES.

ARUM. An extensive genus of perennial herbaceous plants, of the order Aroidæ. Most are stemless, and of very singular appearance; and the roots of all are fleshy, hot, and acrid, yet, in many instances, are eatable. The common species, *Arum maculatum*, is a native of Great Britain; about thirty species have been introduced from North America, China, Japan, Ceylon, the East Indies, the south of Europe, the Levant, and the West Indies; and about fifteen other species are known to botanists. Seven of the introduced species are hardy; and all the others are more or less tender. About one-third are ornamental plants; and most of the others are cultivated, in their native country, for food and medicine. Four are evergreen under-shrubs, of from 3 to 5 feet in height; two are evergreen parasites, of 6 feet in height; seven are evergreen herbaceous plants, of from 1 foot to 3 feet in height; six are tuberous-rooted plants, of from 6 inches to 2 feet in height; and the others are deciduous herbaceous plants, of from 1 foot to 3 feet in height.

Arum maculatum is popularly called wake-robin, and grows wild in woods and on shady banks in most parts of Great Britain. Its ordinary height is about a foot; its leaves are stalked, erect, and broadly arrow-shaped; its flowers are white, and appear from May till July; and its root is a whitish tuber, about the size of a large nutmeg, and is used for both food and medicine.

The leaves of one variety of the species are plain; and those of another variety are full of black spots. The fresh roots, immediately on being tasted, seem insipid and merely mucilaginous; but they soon produce a pungent, prickly, painful sensation, which a man is glad to alleviate by means of oil, butter, or milk. If the roots be taken up when the leaves have decayed, they will retain all or very nearly all their acidity for a twelvemonth; but if gathered in spring, when the leaves are in full vigour, they rapidly dry, shrink, lose all their acidity, and become farinaceous, and fit for boiling or baking. In the Isle of Portland, where the plant is very common, they are not only eaten by the poor inhabitants, but manufactured into a kind of British arrow-root, which has some resemblance in property to potatoe starch, and is sent to London for sale under the name of Portland sago. The French manufacture from the dried roots a cosmetic, which they call cypress powder. The roots, though assigned a place in the *Materia Medica*, are rarely used in regular medical practice; yet they figure largely as a cure for rheumatism, among the peasantry of the south of England. A popular provincial name of the plant is lords and ladies.

The cocoa-root species, *Arum esculentum*, is extensively cultivated in Jamaica, for the sake of its edible roots. It is cultivated in very nearly the same manner as the potatoe; and its root somewhat resembles the Indian yam, but lasts for several years. Two principal varieties are in cultivation, called the Bourbon cocoas and the country cocoas.—The common dragon species, *Arum dracuncululus*, a native of the south of Europe, and introduced to Britain in 1548, might be grown in England for the same purposes as our indigenous species. Yet the plants of it have some singular properties, and a very remarkable appearance; the stems of their leaves are spotted with brown and purple, like the belly of a snake; and their flowers have an extremely offensive smell, resembling that of putrid flesh.—The Egyptian species, *Arum colocasia*, is cultivated in Egypt and the Levant as an esculent; and though not a very delicate kind of food, is esteemed to be wholesome. Its leaves resemble those of the water-lily; and its roots are large, thick, oblong, and tuberous.—*Loudon's Encyc. of Plants and Agr.*—*The Gardener's Magazine*.—*Withering's Botany*.—*Miller's Dictionary*.

ARUNDINARIA,—popularly *Cane-Brake*. A genus of grasses, of the bamboo tribe. The species *macrosperma*, or long-seeded, is a native of North America, and was first brought to Britain in 1809; it grows to the height of 10 feet, has paniced flowers, and blooms in June. The glaucous species, *Arundinaria glaucescens*, called by Willdenow *Ludolfia glaucescens*, and by Lamarck *Panicum glaucescens*, is a curious hothouse plant, recently introduced from India.

ARUNDO,—popularly *Reed*. A genus of grasses, of the bromæ tribe. It was formerly of very

great extent; but, in consequence of the subdivision of old genera by modern botanists, it has become much limited. The total number of species which still figure under the name of *Arundo* in systematic works is upwards of thirty; and three of these are indigenous in Great Britain, while two have been introduced to this country from Germany and the south of Europe.

The cultivated species, *Arundo donax*, forms the type of the genus as now constituted; it is a native of the south of Europe, the Caucasian mountains, Egypt, and Siberia, and was introduced to Britain from the first of these regions in 1648; it grows to the height of 10 feet, flowers in July and August, and sometimes has leaves as broad and long as the blade of a small sword; it is cultivated in Italy and the south of France for fishing-rods, fences, vine-supporters, and several other purposes; and it is grown and prepared in Spain and Portugal for exportation to Britain as material for weaver's - reeds, fishing - rods, and other similar implements. A dwarf and striped variety of it, botanically called *Arundo versicolor*, is the well known and handsome gardener's garters of cottage gardens.

The common species, *Arundo phragmites*, grows wild in the ditches of Great Britain, has a height of about six feet, and blooms from July till September. It is used for protecting sea-embankments, thatching houses, ceiling cottages, constructing rustic verandahs, laying the bases of mortar-floors, and forming hot-bed covers for tender culinary plants. Its flowers are a green dye for wool; and its roots are said to have some good medicinal effects in diseases of the liver.—The wood species, *Arundo epigejos*, classed by Sowerby and Smith as a calamagrostis, grows wild in moist woods in Britain, has a height of two feet, and flowers in July.—The upright species, *Arundo stricta*, grows wild in the marshes of Scotland, has a height of 1½ foot, and flowers in July and August.

The sea-reed, marrum, or mat-grass—though called by some modern botanists *Ammophila arundinacea*, and by others *Psamma arenaria*,—was formerly known to all botanists, and is still best known to many as *Arundo arenaria*, and may be noticed more appropriately here than under either of its new names. It grows in vast abundance on the sea-coasts of Britain, and of other maritime countries of Europe. It pierces the sand banks of the shores with its tough subterranean stems, and in consequence converts them into powerful barriers against the inroads of the ocean; and it is planted and extended on the sandy, exposed, and mouldering coasts of Norfolk and of Cornwall, and amazingly protects them from the destructive action of wind and tide. A Scottish parliament at a remote date passed an act for the preservation of this plant and of *Elymus arenarius* on the coasts of Scotland; a British parliament, in the reign of George II. 1742, passed an act for their preservation on

the north-west coasts of England; and so rigidly do these plants continue to be protected by law, that they may not be anywhere cut on the coast by even the proprietors of the soil, except by such parties as claim prescriptive right of cutting it on the sea-coasts of Cumberland. The sea-reed is very rigid, has bluish rolled-up leaves, and a stem two or three feet high, terminates in a dense tuft of flowers, and blooms in the months of June and July. It is used for thatch, mats, ropes, hats, and several other purposes; yet, though it contains a large proportion of saccharine matter, it is quite unsuited for cultivation as food.—*Sinclair's Hortus Gramineus Woburnensis*.—*Withering's Botany*.—*London's Encyc. of Plants*.—*Miller's Gardener's Dictionary*.—*Transactions of the Royal Geological Society of Cornwall*.—*Larson's Agriculturist's Manual*.

ASAFÆTIDA. A gum-resin derived from incisions made in the upper part of the root of the *Ferula asafœtida* and *Ferula Persica*, both hardy, herbaceous, perennial-rooted plants, growing among the mountains of Chorasan and Laar in Persia. It is light yellow, becoming darker by age; and consists of agglutinated tears or masses. It has a strong, and to many persons, a disagreeable odour and taste. Becomes softer in the hands; burns with a clear flame; imperfectly soluble in water, forming a milky emulsion; best dissolved by alcohol containing acid or alkali. Brande's analysis of the gum-resin gave resin 48.85, volatile oil 4.6, gum 19.4, traces of potash and lime salts, with sulphuric, phosphoric, acetic, and malic acids, bassorin 6.4, extractive with acetate and malate potash 1.4, malate of lime 0.4, sulphate of lime, with traces of sulphate of potash 6.2, carbonate of lime 3.5, oxide of iron and alumina 0.4, water 6.0, foreign admixture of sand and vegetable fibre 4.6. The volatile oil, which gives the characteristic odour to the gum-resin, is obtained by distilling the latter with water or alcohol; it is very volatile, lighter than water, at first clear and colourless, acquiring a yellow tint by exposure to the air; taste at first mild, then bitter and acrid; soluble in every proportion in alcohol and ether, but requires 2,000 parts water for solution. It contains sulphur. The resinous matter of asafœtida is soluble in alcohol. When the alcoholic solution is mixed with water, a milky fluid is formed, owing to the deposition of the hydrated resin. Oil of turpentine and the oil of almonds also dissolve the resin, but less readily than alcohol. Besides its usefulness in medicine, it is employed among oriental nations (in Persia, &c.) as a condiment, either alone, or to flavour sauces and other food. The green leaves of the plant, as well as the roasted roots, are eaten. Captain Pottinger, in his Travels in Beloochistan and Scinde, speaks highly of the asafœtida plant, as a vegetable which is eaten stewed, having the appearance of a cauliflower, and held in so very great esteem as to cause quite

a scramble in the market when brought down from the mountains. Yet one of the two species which produce it has been in Britain since 1762, and does not seem to have particularly challenged the notice of either gardener or gourmand. The gum itself, especially when burning, in the most revoltingly fetid of all vegetable substances.

ASARABACCA,—botanically *Asarum*. A genus of small, evergreen, hardy, herbaceous plants, of the *Aristolochia* tribe. All are inconspicuous, and grow to the height of only six or nine inches. Three species, the arum-leaved, the Canadian, and the sweet-scented, produce brown flowers, and have been introduced from respectively North America, Canada, and Virginia; and the common species, *Asarum Europæum*, grows indigenously in the woods of England, and produces purple flowers in May. The roots of this indigenous species are thick, fleshy, and jointed, and have fibres from every part of their body; the leaves grow singly on short foot-stalks, arising immediately from the root; and the flowers grow upon very short foot-stalks close to the ground, so as to be concealed beneath the leaves. The leaves have emetic, cathartic, and diuretic properties, and are very powerfully sternutatory. A small proportion of the powdered leaves mixed with tobacco snuff occasions violent sneezing; and a moderate dose drawn into the nostrils, on several successive nights at bed-time, occasions a copious and long-continued nasal discharge. "The powder of this herb," said Miller in 1764, "has been strongly recommended by the inhabitants of Norfolk, for cattle troubled with the late raging distemper, which, if blown up their nostrils, will occasion a violent discharge from the head by the nostrils; and this, they have affirmed, has cured great numbers of cattle, which were at the last stage of the distemper."

ASCARIDES, or **NEEDLE-WORMS**. Small intestinal worms in the horse. They have a needle-like form, with flattish heads; and some of them are white, others azure-coloured. They seem to make their lodgment in the upper part of the small intestines, near the stomach; but they often accumulate in the large intestines, and descend in hundreds to the rectum. They breed at all times of the year; and frequently when one brood is destroyed, another succeeds. They do not occasion any mortal disease, or even, in general, incapacitate a horse for his work; yet they cause much pain and sickness, they impair the appetite and reduce the strength, they sometimes prey like an intermitting pest upon the constitution, and they are always troublesome and very difficult to be exterminated. Even when a horse which is infested with them feeds heartily, and does his work tolerably well, he always looks lean and jaded, he often strikes his hind-feet against his belly, he frequently pauses in eating under a paroxysm of sickness or strong griping, and he betrays other symptoms of serious uneasiness and

decided want of health. A smart purge in the stable sometimes brings away the ascarides in vast numbers; but an injection of linseed oil, or of a solution of aloes in warm water, is much more suitable and effective when they have accumulated in the rectum.—*Gibson on the Diseases of Horses*.—*Youatt on the Horse*.

ASCENT OF SAP. The ascent of liquid in plants from the spongioles to the leaves. The liquid nutriment of plants, when imbibed from the soil by the absorbing organs, are designated sap or lymph; they appear to undergo some chemical change in the very process of absorption, so as to possess a different nature in the plant from that which they possessed in the soil; and they are immediately conveyed from the roots to the leaves, or to analogous organs in aphyllous plants, in order to undergo such further chemical change or complete elaboration as shall fit them to become portions of the fixed or permanent vegetable substance.

The internal flow of sap in plants is familiar to the most common observers; and may readily be ascertained by wounding any of the more juicy trees or shrubs. If the trunk, branch, or upper root of a tree be cut or fractured in spring, whether by accident or by intention, the sap will immediately begin to be discharged in a stream or trickling technically called bleeding; it will, in some instances, continue to flow out during several days, or till the wound begins to be healed; and, after it stops, it may be made to commence a fresh discharge, simply by renewing the wound. The bleeding of plants is particularly conspicuous and abundant in the pruning of vines and the piercing of sugar maples; yet, neither in these instances, nor in others in which it is copious, does it appear to occasion any serious injury to the plant's constitution or growth. Even some individual vines which have been profusely pruned with the view of causing the most copious bleeding, have grown as vigorously and fruited as plentifully as if they had experienced the mere routine culture. The bleeding of plants is always most abundant about the time of the opening of the bud; it diminishes in copiousness as the leaves expand and mature; and, in most deciduous perennial-stemmed plants, it cannot occur at the falling of the leaf or during the period of winter. Yet the internal flow of sap, at even the most dormant season, though in a very diminished degree compared to the energetic period of spring, is proved by the gradual development of leaf-buds during winter, the retention and succulency of the leaves of evergreens throughout the year, the florification of mosses amidst the snows of December, the growth of the radical fibres, the succulent stems, and the juicy flower-buds of bulbous plants during the coldest season of the year, and the capability of palms, and other endogenous woody plants, to bleed in autumn and winter, as well as in summer and spring.

The fact of an internal flow of sap is thus exceedingly obvious; and the fact that the sap discharged by bleeding is in the course of ascent, and not of descent, though not quite so obvious, is capable of easy proof. If several wounds are simultaneously made at different heights in one tree, the lowest will bleed before the others, and each succeeding one will bleed before that above it; if a branch or stem of a vine be lopped asunder, the standing part will bleed copiously, and the part cut off will not bleed; and if any large or wide incision in the trunk of a tree be examined, the bleeding may, on minute inspection, be easily observed to proceed almost wholly from the lower side. But especially if any fibrous rooted or ligneous plant, with semitransparent bark, be carefully lifted from the soil and immediately placed in radical contact with any inactive coloured infusion, such as pure water tintured with madder root, the ascent of the coloured liquid will speedily be observed from the roots to the very summit of the stem or extremity of the larger branches, appearing in the interior of the plant like very slender longitudinal streaks or threads. Even the very velocity of the sap's ascent has been made the subject of calculation. "To the stem of a vine cut off about two feet and a half from the ground, Hales fixed a mercurial gauge, which he luted with mastich. The gauge was in the form of a syphon, so contrived that the mercury might be made to rise in proportion to the pressure of the ascending sap. The mercury rose accordingly, and reached as its maximum to a height of 38 inches. But this was equivalent to a column of water of the height of 43 feet 3½ inches, demonstrating a force in the motion of the sap that, without the evidence of experiment, would have seemed altogether incredible."—[Keith.] In a newly developed herbaceous stem, which as yet contains little fibrous or vascular tissue, the sap ascends chiefly through the pith; but in woody exogenous trunks, it rises through the alburnum or sap-wood; and in endogenous stems it is supposed to ascend through the bundles of fibrous and vascular tissue which constitute the wood.

The cause of the sap's ascent has been a prolific topic of disputation and theorizing among phytologists; yet, in spite of the mystery which hangs over even our most profound ideas of life, but with recognition of the peculiar and irresistible power which the principle of life exerts, it may be simply and very satisfactorily resolved into mere vegetable life,—or, as Keith more learnedly expresses it, "the agency of the vital energies or affinities of the plant, merely with the subordinate aid of molecular infiltration." But Grew ascribed the ascent of the sap to capillary attraction, and to volatility and magnetic tendency; Malpighi ascribed it to the contraction and dilatation of air in the sap vessels by means of valves; De La Hire ascribed it to the combined agency of capillary attraction, and

valvular contraction and dilatation; Duhamel ascribed it to the combined agency of humidity and heat; the elder Saussure ascribed it to a peculiar vital irritability similar to the peristaltic movement in the intestines of animals; Dutrochet ascribed it to the reciprocating agency of the positive and the negative electricities, or to an electric imbibition and exudation which he designated endosmose and exosmose; and De Candolle ascribes it to a vital contractility in the cells similar to the systole and diastole of the heart of animals. The whole question of the cause of the sap's ascent, however, is too abstruse, too much a matter of mere philosophy, to be worth a farmer's serious attention, or to be capable of conversion to any very useful purpose. Even the channel of the sap's ascent may, for all practical ends, be simply identified, in a general manner, with the softer tissues between the bark and the pith, and principally with the tubes of the alburnum.

ASCLEPIAS. The extensive genus of ornamental herbaceous plants, popularly called SWALLOW-WORT: see that article. The extensive natural order Asclepiadæ has the genus asclepias for its type, and comprises no fewer than twenty-four genera. This order is distinguished from every other by having its grains of pollen in a state of mutual waxy coherence within a sort of bag in the cells of the anthers. The plants of the order are shrubs or herbs; they abound in an acrid and usually milky juice; and they are for the most part poisonous, and yet in several instances are wholesome and nourishing in their young shoots. Some are excessively fetid; some are almost as powerfully emetic as the ipecacuanha of the drug-shops; and not a few have a curious appearance, and are more or less ornamental. The most profuse vegetation of the order occurs within the tropics.

ASH,—botanically *Fraxinus*. A large and important genus of timber and ornamental trees, of the olive-tree tribe. The English name is derived from a Celtic word which signifies a pike, and appears to have been suggested by the general use of sticks and branches of ash for the long handles of implements; and the botanical name is derived from a Greek word which signifies separation, and appears to have been suggested by the facility with which ash timber splits. The trees of the genus, particularly those which grow indigenously in England, or which have been easily naturalized, are superior, for both utility and ornament, to all other tribes of hardy trees excepting the oaks, the pines, and the firs. Three species, the common, the warted, and the various-leaved, are natives of England; one, the Caucasian, is a native of the mountains of Caucasus, and was introduced to Great Britain in 1815; one, the narrow-leaved, though probably but a variety of the Caucasian, is a native of the south of Europe, and was introduced in 1821; two, the Aleppo and the small-leaved, are natives of the

Levant, and were introduced in 1710 and 1822; one, the silvery, is a native of Corsica, and was introduced in 1825; about twenty-six other introduced species are natives of North America, and were introduced at various dates between 1723 and 1825, but principally during the last four years of that period; and five or six other species known to botanists have not yet been introduced. The flowering-ash and the mountain-ash, however, are excluded from these statements; for they botanically possess quite different names and characters, and they will form the subject of our two next articles.

The common ash, *Fraxinus excelsior*, is much the tallest, most conspicuous, most valuable, and most widely diffused species, and requires to be noticed at some length, both on its own account, and as an imposing specimen of the genus. It grows naturally in the woods of most parts of Great Britain; it has been very extensively planted, in almost all the methods of forestry from the isolated tree to the grand expanse of wood; it has an appearance at once arresting, imposing, and full of character; and it is, in consequence, known to all observers, and quite familiar to even the majority of children. Its very notoriety occasions it to be regarded by many feeble minds as somewhat vulgar, and requires a little effort of taste and judgment in order to the full appreciation of its extraordinary nobleness and beauty. It is, beyond all question, a tree of surpassing elegance, whether viewed in itself, or contrasted with trees of heavier foliage. "I have sometimes," says Gilpin, "heard the oak called the Hercules of the forest, and the ash the Venus. The comparison is not amiss; for the oak joins the idea of strength to beauty, while the ash rather joins the ideas of beauty and elegance. Virgil marks the character of the ash as particularly beautiful,—'*Fraxinus in sylvis pulcherrima*.' The ash generally carries its principal stem higher than the oak, and rises in an easy, flowing line. But its chief beauty consists in the lightness of its whole appearance. Its branches at first keep close to the trunk, and form acute angles with it; but as they begin to lengthen, they generally take an easy sweep; and the looseness of the leaves corresponding with the lightness of the spray, the whole forms an elegant depending foliage. Nothing can have a better effect than an old ash hanging from the corner of a wood, and bringing off the heaviness of the other foliage with its loose pendent branches."

The common ash usually grows to the height of about 80 feet, but often exceeds 100, and sometimes attains to upwards of 120. Its branches are flatly smooth; its leaflets are generally arranged in five pairs, with an odd one at the end, and are of a very dark green colour, somewhat stalked in position, pointedly spear-shaped in form, and slightly serrated in the edge; and the flowers have a green colour, are produced in long spikes from the side of the branches, and bloom

in April and May; and the seeds or "keys" which succeed the flowers are flat, and ripen and fall in autumn. This elegant tree, however, is among the latest of our hardy ornamental trees to foliate in spring, and one of the earliest to suffer defacement and lose its leaves in autumn. When it occupies a conspicuous place in the home-view of a park, it gives to the surrounding grounds a late and cold appearance in spring; and when growing in any exposed situation in either field, park, or forest, it sustains great and irreparable injury from the earliest frosts or tempestuous winds of autumn, and, instead of contributing a mellow tint to the scenery of the landscape, shrinks from the blast, drops its leaves, and presents wide blanks of desolated boughs amidst surrounding foliage and verdure. Its leaves and rinds are likewise so greedily eaten by sheep, cattle, and deer, and form so constant and favourite a portion of the forage of the last of these, that such trees as are not specially protected by situation or fences present, in the very blush of summer, a mangled and deformed appearance. Yet a frequent compensating feature is the formation on the tree's leading branches of a sort of excrescence called a wreathed fascia. A branch which possesses this curious feature is beautifully twisted and curled, and occasionally seems decorated as with a ram's horn, a crosier, or a piece of arabesque tracery. The fascia has been ascribed by some naturalists to a too rapid ascent of the sap; yet really seems occasioned in every instance by the operation of insects; and, though often seen in the willow, the holly, and some other trees, is most characteristic of the ash.

An ash of 132 feet in height, is mentioned by Evelyn; and one of 70 feet high, in the thirty-fifth year of its growth, is mentioned by Arthur Young. In 1784, an ash in the churchyard of Bonhill, in Dumbartonshire, measured 17½ feet in girth at 4 feet from the ground, and 33 feet in girth at one foot from the ground; it divided into three great arms, at the height of 6 feet; and it had a vast spreading head, and was obviously of great age, yet did not measure more than about 50 feet in total height. An ash at the burying-place of the Lochiel family in Lochaber was long regarded as the largest tree in the Scottish highlands, but was revengefully burnt to the ground in 1746 by the Hanoverian soldiery; and in 1764, its stump, at the surface of the ground, was ascertained to have an extreme diameter of 17 feet 3 inches, a cross diameter of 21 feet, and a circumference of 58 feet. An ash at Earlsmill in Morayshire is noticed by Sir Thomas Dick Lauder as one of the most magnificent trees he ever beheld; it measured upwards of 17 feet in girth at 3 feet from the ground; it had in its trunk a cavity sufficiently large to allow three persons to stand in it upright; and, though it had contained that cavity during the memory of the oldest inhabitants of the district, it had a surpassingly grand head, formed of three enormous

limbs variously subdivided in bold sweeping lines.

The ash will grow on any kind of soil, but attains its greatest bulk and vigour upon clayey loam. But scarcely any tree is so hurtful as the ash to all sorts of neighbouring vegetables; for it occupies a comparatively great breadth of site by its roots, impoverishes or exhausts all the soil of that site, and robs every adjacent plant of every degree of requisite nourishment. It ought never, therefore, to be allowed to grow in hedge-rows; for it will both kill the hedges, and impoverish the portion of any kind of crop which may be grown in their vicinity. Nor ought it to be permitted to grow within reach of cattle, not only because it will itself sustain damage from being browsed, but because it gives a rank taste to all the butter from the milk of cows which eat its foliage,—though, says an old writer, “the ashen boughs are first chewed even to admiration before any other by the tender-mouthed heifer.” “Close groves,” says Marshall, “are the only proper situation for the ash; its uses require a length and cleanness of grain; and it would be well for the occupiers of land, and indeed for the community at large, if a severe penalty were laid upon planting it in any other situation. But we know of no species of timber so likely to be worn out in this country as the ash. The just complaints of the husbandman are expelling it very properly from our hedges; and we are concerned to see, amongst the numerous plantations which have of late years been made, so few of this necessary tree. It is therefore more than probable that no tree will pay better for planting; not however in single trees and hedge-rows, but in close plantations.”

The seeds of the ash readily germinate where they fall, and, if not counteracted by cattle or tillage, will spontaneously produce young plants. Most natural seedlings, however, are either cropped by cattle, removed by husbandry, or drawn up in so slender and ill-rooted a form as to be undesirable for planting. Seeds intended for propagation ought to be carefully collected from a good tree, dried in a cool airy loft, preserved in sand during winter, and sown on prepared beds of fresh mellow soil in March or April. The depth for proper sowing is from one inch to two inches, according to the stiffness or the lightness of the soil; for if the seeds be sown too deep in a close-textured soil, they are in risk of being smothered, and if sown too shallow in a porous soil, they are in risk of being damaged by drought or disturbed by the process of weeding. As the young plants will not appear till next spring, the seed-bed ought, by means of the hoe and the rake, to be kept quite clean from weeds during summer and autumn. On the approach of next spring, the surface of the beds ought to be finely pulverized in order to give free admission of air to the embryo plants, and even a thin stratum of the soil may be removed, and some fresh earth sifted

over in its stead, in order to supply influence and nourishment for rendering the young plants additionally vigorous. When plantations are made with a view to profit, the trees ought to be planted at very little more, if any, than 4 feet apart in each direction; but if intended for underwood, they may be planted so close as two feet between each two rows, and 12 or 14 inches between each two plants. At the end of the first year after planting, or in the April immediately subsequent to the plants having had one summer's growth and one winter's consolidating repose, they ought to be cut down nearly to the ground. At the end of six or seven years, all the alternate rows of the underwood plants, and all the alternate plants in the remaining rows, ought to be taken out, and sold for hoops; at the end of ten years, the remaining plants, if well treated and growing upon a good soil, will make hop-poles of 20 feet in length; or if left standing till the end of 12, 15, or 16 years, they will be fit for the uses of wheel-wrights and for many other purposes to which ash timber is applied; and if these plants are removed by cutting, their stumps will send up a second crop, which may either be all managed for the same purposes as the first crop, or thinned out in a few years with the view of their growing into lofty forest trees. The growth of the ash is remarkably rapid; and its propagation cultivation, and management, are nearly as easy as those of a cabbage. A calculation is made, in the ‘Gardener and Forester's Guide,’ that one acre of ash planted as underwood will produce, in ten years, £87 worth of hoops, £290 worth of hop-poles, and as much faggot-wood as would compensate the labour of planting and managing, and that the cost of rent, taxes, fencing, cutting down and trimming will not exceed £4 or £5 per acre per annum, or a total of £40 or £50 for the ten years, or, in the most extreme supposable case, £100.

Ash timber is remarkable for a combination of toughness, hardness, and elasticity, and possesses perfect adaptation to a considerably wider range of useful purposes than any other timber. Its cohesive power reduced to a square inch rod was estimated by Barlow in one specimen at 17,670 lbs.; in another at 15,784 lbs.; while teak gave 15,000 lbs., and fir from 13,448 to 11,000 lbs. A piece of young ash 2·5 feet in length, by 1 inch in breadth and depth, broke with a transverse strain of 324 lbs.; while a similar piece of young oak supported 482 lbs.; and of Memel fir 218 lbs. “This tree, in point of utility,” remarks Gilpin, “is little inferior to the oak. Its uses are infinite. To the ashen spear, the heroes of antiquity were indebted for half their prowess. In the arts of peace as well as of war, in architecture, tillage, and manufactures, the ash objects to business of no kind; while even its very refuse spars are accounted the best fuel in the forest.” “The use of ash,” says Evelyn, “is next to oak itself, one of the most universal. It serves the soldier, car-

penyer, wheel-wright, cart-wright, cooper, turner, and thatcher. Nothing like it for our garden palisade-hedges, hop-yards' poles and spars, handles, stocks for tools, spade-trees, &c. In sum, the husbandman cannot be without the ash for his carts, ladders, and other tackling. From the pike, spear, and bow, to the plough, in peace and war, it is a wood in highest request. Lastly, the white and dotted rotten part composes a ground for our gallants' sweet powder; and the truncheons make the third sort of the most durable coal, and is the sweetest of our forest fuelling, and the fittest for ladies' chambers." The ashen billet produces a steady, bright, lambent flame; it readily burns when recently taken from the tree; it exudes much sap during the process of combustion; and it appears to owe its bright flame to the plentiful and progressive evolution of hydrogen. The coach-maker very extensively uses ash timber; and the cabinet-maker often passes it upon his customers as fancy-wood or green ebony. The timber of the roots is often finely veined; it sometimes has knotty convolutions which beautifully resemble certain animals or compound figures in nature or in art; and it is usually susceptible of a fine polish. The bark of the tree is used for tanning calf skins, and for dyeing green, blue, and black; the ashes of trunk, root, or branches, are comparatively rich in potash; the 'keys' were formerly gathered in their green condition, and pickled with salt and vinegar for sauce; and the dried seed was in high repute for medicinal virtues, among the Greeks, the Romans, the Arabs, and the early English physicians.

The weeping ash, *Fraxinus pendula*, is a variety of the common ash, characterized by rapidly curved and deeply pendulous branches. It was first discovered in a field at Gamblingay in Cambridgeshire; it usually attains a height of only about 20 feet; and, if thoroughly and constantly protected by fence, it is both a curious object in itself, and forms an agreeable circular arbour; but when it grows within access and reach of cattle, it is certain to be deformed and irretrievably damaged.—The yellow-barked ash, *Fraxinus jaspidea*, is also a variety of the common ash, characterized by the yellowness or variegation of its bark; and usually grows to the height of about 30 feet.—The green curled-leaved ash, *Fraxinus atrovirens*, is likewise a variety of the common ash; but is so exceedingly dwarfish as to be a mere bush, the only shrubby plant of the genus, usually growing to the lilliputian height of only 4 feet.—The horizontal, the erose-leaved, the striped-barked, horizontalis, erosa, striata, and some other varieties, are also varieties of the common ash; and, in common with all the preceding varieties, may be propagated from buds, layers, or grafts.—The simple-leaved ash, *Fraxinus simplicifolia*, is regarded by some as a variety of the common ash, and by others as a variety of the *Fraxinus heterophylla*. It is distinguished by having leaves, not pinnated, but single; and it

possesses no superior point of either utility or beauty, but is a mere curiosity. A tree of it upwards of 50 feet in height grows in the Edinburgh Botanic Garden, and produces seeds; but plants raised from its seeds have the pinnated leaves of the common ash.—The warted ash, *Fraxinus verrucosa*, grows wild in Norfolk, is distinguished from other species by its round warted branches, has an ornamental character, and usually attains a height of about 60 feet.—The various-leaved ash, *Fraxinus heterophylla*, grows wild in the woods of England, is distinguished by the blackness of its buds and by having its leaves tooth-serrated and both simple and compound, is better adapted to utility than to ornament, and usually attains a height of about 30 feet.

The white ash, *Fraxinus Americana*, is a lofty tree, differing in few respects from the common ash, and the only American species which has yet been proved to rival the common ash in value. It was introduced to Britain from North America in 1723, and has long been known in France and Germany. It chiefly abounds, in its wild state, to the north of the river Hudson; it prefers a decidedly cold climate, by the sides of swamps and rivers; and it usually attains a height of 80 feet, with a medium trunk diameter of 3 feet. Its bark has a whitish colour, and, on large trees, is deeply furrowed, and divided into squares of from one inch to three inches in diameter; its trunk is perfectly straight, and sometimes does not ramify till the height of upwards of 40 feet from the ground; and its leaves are 12 or 14 inches in length, composed of three or four opposite pairs of leaflets with an odd leaflet at the end, covered in spring with a light down, but quite smooth in summer, of a light green colour on the upper surface, and a whitish colour on the lower side. The timber of the tree has a reddish colour. The leaves of the white ash are said to be so highly offensive to the rattlesnake that that formidable reptile is never found on land where it grows, and it is the practice of hunters and others having occasion to traverse the woods in the summer-months, to stuff their shoes or boots with white ash leaves as a preventive of the bite of the rattlesnake.—The blue ash, *Fraxinus quadrangulata*, grows wild in Tennessee and Kentucky, and was introduced to Great Britain in 1822. It frequently attains a height of upwards of 70 feet. Four opposite membranes, of a greenish colour, and three or four lines broad, extend throughout the length of the young shoots, to which the leaves are attached; but after the third or fourth year, these membranes disappear, and leave only the traces of their existence. This species is so extensively and richly useful in its native country, as to be well worth cultivation in the woods of Europe.—The red ash, *Fraxinus tomentosa* or *pubescens*, grows wild in Pennsylvania and some adjoining districts. It is a beautiful tree, and attains the height of 60 feet. Its bark is of a deep brown

colour; and its timber, in a mature state, is of a brighter red than that of the common ash.—The green ash, *Fraxinus viridis*, *concolor*, or *acuminata*, grows wild in Pennsylvania, and is easily recognised by the brilliant green of both surfaces of its leaves. It is perfectly hardy in Great Britain, and is much esteemed for the beautiful tint of its foliage.—The Carolinian ash, *Fraxinus platycarpa*, grows wild on the marshy borders of creeks and rivers in North Carolina. It rarely exceeds 30 feet in height, but has a beautiful foliage.—The black or water or elder-leaved ash, *Fraxinus sambucifolia*, grows wild throughout the northern division of the United States, and was introduced to Great Britain in 1800. It has decidedly aquatic habits, loving a swampy soil, exposed to inundations; and it attains a height of 60 or 70 feet. Its buds are of a deep blue colour; its young shoots are a bright green, temporarily dotted; its bark is of a duller hue and less deeply furrowed than that of the white ash, and has the layers of its epidermis applied in broad sheets; and its timber, in a mature condition, is brown, and finer, tougher, and more elastic than that of the white ash, but less durable when exposed to alternations of dryness and moisture.—The numerous other species and varieties of American ash have not yet been fairly investigated as to their useful properties; but they grow freely in our gardens, they generally possess beautiful foliage, they promise to be, without exception, pleasingly ornamental, and all, or very nearly all, probably form both fine trees and valuable timber.—The Aleppo ash, *Fraxinus lentiscifolia*, introduced from the Levant in 1710, is a mere shrub of six feet in height, but forms a charming member of a shrubbery.—*Gilpin's Forest Scenery*.—*The Gardener's and Forester's Guide*.—*Treatise on Ornamental Planting*.—*Loudon's Encyclopædia of Plants*.—*Miller's Gardener's Diction*.—*Nicol's Planter's Calendar*.—*Marshall on Planting*.—*Doyle's Practical Husbandry*.—*Pontey's Profitable Planter*.—*Sir John Sinclair's General Report of Scotland*.—*Sir John Sinclair's Code of Agriculture*.—*Withering's Botany*.—*American Journal of Science and Arts*, vol. xxiii.

ASH (FLOWERING),—botanically *Ornus*. A small genus of ornamental, deciduous trees, of the olive-tree tribe. They grow to the height of about 30 feet, and carry white flowers. Only five species are known to us, the European, the American, the striated, the many-flowered, and the manna. The European flowering ash, *Ornus Europæa*, was formerly ranked as a true ash, and called *Fraxinus ornus*,—and, in fact, is still very frequently so designated. Its leaflets are of a fine green, attenuatedly lance-shaped, smooth, serrated, placed a good way asunder along the midrib, in three or four, with usually an odd one at the end; the midrib is long, but not straight; the flowers are produced in large bunches at the ends of the shoots; the buds begin to swell in autumn, and have a black-

ish hue; and the branches have nearly the same appearance in winter as those of the common ash, but are darker in colour. “The flowers,” remarks Hanbury, “exhibit themselves, not in a gaudy dress, but in a loose easy manner, all over the tree, which, together with the green leaves peeping from amongst this white bloom, makes the appearance extremely pleasing.”—The American species, *Ornus Americana*, was introduced from North America in 1812. It is quite hardy, and usually attains a height of about 30 feet.—The striated species, *Ornus striata*, was introduced from North America in 1818; and is also quite hardy.—The many-flowered species, *Ornus floribunda*, is a native of Nepal, and was introduced to Great Britain in 1822. It is called by the Nepalese kanga and tahasee; and in Britain, it is somewhat tender.—The manna species, *Ornus rotundifolia*, is a native of Italy, and particularly abounds on the skirts of the mountains of Calabria. It was formerly regarded as a true ash, and called *Fraxinus rotundifolia*; and it still occasionally receives that name. In Britain, it is a hardy plant, but seldom attains a height of more than 20 feet. Its leaflets are shorter, of a darker green, and more deeply serrated than those of the common ash, and they are nearly sessile. The well-known medicinal substance called manna,—a mild, slightly nauseous, highly saccharine, concrete mucilaginous juice—is obtained partly from *Fraxinus virgata*, partly from some other species of ash, and partly from *Tamarix mannifera*, but principally from *Ornus rotundifolia*. From the middle of June till the end of July, the manna-gatherers make a horizontal incision in the stem of the trees; and on next day, they deepen this incision, and so insert a maple-leaf as to form a sort of cup for the reception of the exuding juice or gum. Straws or small bits of reeds or twigs are also placed in contact with the oozing fluid; and the stalactites which form on these small bodies are separated, and sold as manna of the finest quality, under the name of manna in tears. The smallest pieces of the exudation form the manna in sorts or flakes; and the common or fat manna is usually mixed with earthy or other foreign ingredients, and is always of the worst quality. The exudation of each tree generally continues during about a month after the making of the incision. The manna on which the Israelites fed in the wilderness was produced by miracle; and probably had not one characteristic property in common with the manna of commerce. The manna flowering ash forms in Britain a decidedly ornamental tree.—*Loudon*.—*Miller*.—*Marshall*.—*Keith's Botanical Lexicon*.—*The London Dispensatory*.—*Anderson's Commercial Dictionary*.

ASH (MOUNTAIN),—botanically *Pyrus aucuparia*. An indigenous deciduous tree, closely allied to the service-tree, the pear-tree, and the apple-tree, and producing blossoms of the rosaceous order. It is popularly called roan-tree or

roan-tree in Scotland and the north of England, and *quickbeam* and *quicken-tree* in the central and southern districts of England; and till quite recently, it was botanically called *Sorbus aucuparia*. Its ordinary English name of mountain-ash, though universal among the educated classes of Great Britain, is an outrageous misnomer; for the tree possesses no characteristic property in common with the *fraxinus* and the *ornus* genera, except some remote resemblance in the form and disposition of the leaf.

The stem of this tree is covered with a smooth gray bark; the branches, while young, have a purplish brown bark; the leaves are pinnated, and consist of eight or nine pairs of leaflets, and a terminating odd one; each leaflet is about two inches long, and half an inch broad toward the base, terminates in an acute point, and is sharply serrated in the edges; the leaves of young trees have on their lower surface in spring a hoariness, which disappears about midsummer, but the leaves of older trees have little of this hoariness; the flowers are produced at the end of the branches, in large bunches, almost in the form of umbels, and they appear in May, are white in colour, and consist of five spreading concave petals similar in shape to those of the pear-tree, but smaller; and the fruit consists of roundish berries, with a depressed navel on the top, growing in large and beautiful bunches, and becoming ripe and brilliantly red in autumn.

This tree grows wild in most parts of Great Britain: and is naturally propagated by birds eating its berries, and afterwards dropping the contained seeds. In the south and the centre of England, it is usually cut down and reduced to underwood, and is in consequence seldom seen of any considerable size; but in Wales, in the north of England, and in the south of Scotland, it very generally grows and flourishes to the height of about 30 feet; and throughout the Scottish highlands, even in situations nearly 2,000 feet above the level of the sea, it often attains a still greater height, and usually contributes a most ornamental feature to the close-views of gorgeous, grand, and thrilling landscapes. "In the Scottish Highlands," remarks Gilpin, "it becomes a considerable tree. There, in some rocky mountain, covered with dark pines and waving birch, which cast a solemn gloom over the lake below, a few mountain ashes joining in a clump, and mixing with them, have a fine effect. In summer, the light green tint of their foliage, and in autumn the glowing berries which hang clustering upon them, contrast beautifully with the deeper green of the pines; and if they are happily blended, and not in too large a proportion, they add some of the most picturesque furniture with which the sides of those rugged mountains are invested." The mountain-ash is, beyond all question, a most handsome tree both in itself and in good grouping with trees of other form and foliage; and were it as rare and tender as it is plentiful and

hardy, it would undoubtedly be a high and universal favourite. But it has suffered great damage to its fame, both by being generally treated as underwood in England, and by being profusely and without any sort of foil grown as the common shelter of cottage-gardens in Scotland. Its hardiness, its facility of growth, its accommodating habits, and certain strong associations of superstition, have occasioned it to stand as almost the sole guardian of an enormous proportion of the smallest and poorest class of Scottish gardens, or—what is still worse—have condemned it into accompaniment with only the commonest poplars and the tree willows. Yet so mighty is its beauty that it triumphs over all this mass of vulgarization, and takes its place among many of the costliest and most tasteful sylvan groupings of suburban villa-grounds, and shares the attention of the nurseryman, in common with the *rhys*, the *robinia*, the *gleditchia*, the *ailanthus*, and all the other deciduous beauties of the arboretum, as one of the pet plants of sylvan decoration.

The mountain-ash has long and undeservedly been regarded as of very trifling practical value. But it grows well on dry and rocky soils, in exposed and elevated situations, and might advantageously be employed for purposes of shelter. Its stem, when of healthy growth, is long and straight; its timber is hard, compact, heavy, and tough; and its shoots from the stool are generally numerous, straight, and long. It appears well worth the planter's notice as underwood; it would yield large and profitable returns if grown for timber upon high, dry, rocky grounds, which yield little pasturage, and are ill adapted for any other tree; its branches and young stems make excellent stakes and hoops; its shoots from old stools are well suited for whip-stocks, goads, and various agricultural tools; its spray and smaller branches, as well as its brushwood, make excellent fuel; and its timber is commended by the wheelwright for being all heart, and, when the trees are large, can easily be sawn into planks and boards, and devoted to a great diversity of uses. But one purpose for which many of the peasantry of Scotland still continue to use it—the superstitious prevention of evil—ought to be everywhere and most stringently discountenanced. Not only are trees grown in the vicinity of cottages, but branches are hung over doorways, and in stables and cowhouses, as spells against the power of fairies, witches, and warlocks. This fact is a horrific outrage upon the professed Christianity of our country; it indicates a dimly low condition in even the ordinary education and common sense intelligence of a large proportion of the people; and it would harmonize far more with the dark heathenism of the pagan age of our remote ancestors, than with the reputed enlightenment of Britain in the nineteenth century. The whole superstition of the roan-tree, in fact, was directly and deeply heathenish in its origin; and stumps of the tree may still be seen

in many old burying-places, or near the circles of Druidical temples, whose vile orgies were performed in association with the shade and branches of the tree as accessories. In Russia the ripe fruit of the mountain-ash is used extensively, in a variety of ways, as an article of food. It is used to form a liquor which is much esteemed as a stomachic, an agreeable bitter, and for diffusing a glow over the system during the winter months. To make this, take a small cask, two-thirds full of the ripe berries, picked and cleaned; fill it with strong spirits, and allow it to stand in a cold cellar for twelve months. Then run off the spirit, which has become completely impregnated with the colour and flavour of the fruit, and comes away perfectly pure, the macerated berries remaining at the bottom. The spirit or tincture is then bottled. The boors or lower class make use of the *watky*, or common fermented spirits of the country, for the above purpose, while the nobility, the higher orders of the people, and foreigners, employ gin, brandy, rum, or other spirits. A glass or two of this liquor is taken each forenoon during the winter-months, and it generally makes its appearance at lunch. Another application of the fruit of the rowan-tree as an article of food, is in the form of jelly, jam, or preserve. To make the jelly, put the berries, when ripe and cleanly picked, into a large jar, which is to be placed either in an oven, or in a saucepan of boiling water, until they part with their juice. Strain through a fine sieve, but do not press the berries; weigh the juice, and add to it an equal weight of loaf sugar; boil them together until they acquire a proper consistence. Rowan jelly thus made has a pleasant, slightly bitter taste, and in appearance resembles that made from red currants. It is eaten in considerable quantity with partridges, the different varieties of wild fowl, &c., which are to be had in any quantity at a trifling price, and constitute a daily dish. The jam is made in the same manner as that of the gooseberry, or any other species of fruit, and forms a good remedy in stomach complaints and sore throats. Lastly, the berries, towards the end of the season, when ripe, are collected in great quantities by the boors, for their own consumption, and for that of the nobles on whose estate they live; and are salted, along with various sorts of wild berries, and preserved amongst their winter store in the ice-cellar. During the winter the berries thus kept form a part of their daily meals, and are reckoned antiscorbutic.

The mountain-ash, though preferring a dry soil of medium quality, will grow upon almost any soil, whether dry or moist, strong or light, deep or shallow, fine or coarse, moderately vegetable or almost wholly mineral; and though unable to bear much wet without considerable detriment, it perfectly braves the bleakest situation, the coldest exposure, and the fiercest and most frequent blast.—Sowings of its berries for nur-

sery-propagation should be made about half an inch deep; and the young plants will appear in the following spring, and ought, a twelvemonth afterwards, to be planted out in the nursery. The seed-bed ought to be kept clear of weeds; the young plants ought, in dry weather, to be occasionally refreshed with artificial waterings; and, after they are planted out in the nursery, all forked shoots ought occasionally to be removed, and the spaces between the rows occasionally cleaned and stirred with the hoe, till the plants are of sufficient size to be removed to their final situation. Propagation of the mountain-ash may likewise be effected by cutting down a tree close to the ground, layering the shoots from the stool next year in the same manner as carnations, and removing the rooted layers, a twelvemonth after, to the spots where they are destined permanently to grow. But trees raised from layers are neither so straight, so large, nor so handsome as trees raised from seed.—*Gilpin's Forest Scenery*.—*Nicol's Planter's Kalendar*.—*Sir John Sinclair's Code of Agriculture*.—*General Report of Scotland*.—*Marshall on Planting*, V. SORBUS.—*Miller's Gardener's Dictionary*, V. SORBUS.—*Dr. Howison in Edinburgh Journal of Natural History*.

ASHES. The earthy and saline remains of the combustion of vegetables, animal substances, or mixtures of minerals with vegetable or animal matters. Most ashes which meet observation, or can be employed for useful purposes, are obtained from fresh or recent plants, or from such dead vegetable matter as still retains its fibrous or cellular character; but many are obtained also from hardened, altered, and ancient vegetable matter, in the form of coal,—many, from mixtures of vegetable and mineral matter in the form of sward,—some from mixtures of principally a mineral character in the form of clayey or loamy soil,—some from substances almost wholly animal,—some from mixtures of vegetable, animal, and mineral matters, in the form of the refuse of yards,—and some from other heterogeneous compounds, of very diversified form and character. When either sound or decayed plants are burnt in the open air, and most of their substance is evaporated or dispersed by thorough combustion, an impalpable and incombustible powder remains, of a flaky appearance, of a whitish colour, soft to the touch, and destitute of both taste and smell. This powder is the only true vegetable ash, the most valuable part of all the substances which are usually designated vegetable ashes, and even the type of all the varieties of the residue of combustion; yet it very rarely exists in a pure condition, it possesses a wide diversity of chemical character corresponding to the different kinds of plants from which it is obtained, and it is almost always modified in both character and action by unburnt portions of the plant, or by the mineral and animal ingredients with which it is mixed. Ashes, therefore, in the practical sense of the

word, or when spoken of in their connexion with agriculture, must not be further identified with this powder than in chemical analysis of their characteristic and most valuable element; but must be understood to include the charred debris of half-burnt wood, the smouldered, shrivelled, and exsiccated leaves and stems of half-burnt herbs, the calcined residue of burnt sward and clay, the incinerated remains of burnt bones, hair, and horns, the cinders of half-burnt coke and coal, the promiscuous contents of every kind of ashpit, the heterogeneous residue of the combustion of all sorts of rubbish, and even the powdery portions of the matter ejected by volcanoes.

Ashes have, in all ages, held a conspicuous place among manures; but, in consequence of their very diversified nature, they have, as a whole, been always ill understood. Both the ancient Jews and the ancient Romans burnt their stubble; and the ancient Britons burnt both their stubble and their straw, and scattered the ashes over their land. Cato recommends the ashes of the twigs and branches of trees as manure; Palladius says that this manure will maintain land in good condition during five years; and a German writer of the sixteenth century, states that the farmers of Lombardy regarded ashes as a much better manure than dung. Such crude notions show that ashes were both greatly and ignorantly appreciated. Even British farmers of the present day universally employ this manure, and, in the great majority of instances, seem unaware of the wide diversity of its composition, and the precise character of its various modes of action; and not a few of them commit egregious errors in applying it, and are quite unable to account for its highly fertilizing power in some circumstances, and its utter uselessness in others. The ashes of wood, turf, and coal, when these substances are used as domestic fuel, are often mixed up with the ordinary contents of the farmyard dunghill,—and, in this case, they occasion little difference in the properties of the compound manure; but when they constitute the principal mass of a dunghill, as in towns and at cottages, they necessarily rule the action of the manure in all its intermixtures with the soil; and when they are applied alone, they very generally act beneficially both as diluents and as top-dressings,—in the former case, loosening and stimulating clays, and heavy tenacious loams,—and, in the latter case, strengthening the herbage, improving its quality, and encouraging the growth of white clover. In order to give a full view of this important, universal, and exceedingly diversified manure, we shall first take a general notice of vegetable ashes, and next particular and successive notices of wood ashes, peat ashes, turf ashes, straw ashes, soap boiler's ashes, coal ashes, bone ashes, clay ashes, and volcanic ashes.

Vegetable Ashes.—The ashes of vegetables vary in composition according to the nature of the

plant, the quality of the soil in which it grows, and the chemical character and action of the manure with which the soil is mixed. Plants which grow in a silicious soil yield ashes which are richer in silica than those of plants of the same kind which grow upon calcareous soil; plants which grow upon a calcareous sand, and plants which grow upon a granitic sand, when these sands have been treated with the same kind of manure, yield the same kind of ashes; and different kinds of plants, though grown on one kind of soil, with one kind of both manure and culture, yield ashes of either different constituent ingredients, or of different proportions of the same ingredients. Yet the constituents of ashes of all varieties seldom if ever exist in the ashes in the same state in which they existed in the plant; but are almost always, or perhaps without exceptions, the altered results of combustion. Potash, soda, lime, silica, magnesia, the oxide of iron, the oxide of manganese, chlorine, phosphoric acid, carbonic acid, and sulphuric acid, are the substances which usually constitute the ashes of land plants; and alumina and oxide of copper have occasionally, yet very seldom, been detected. Of these substances potash, soda, lime, magnesia, alumina, silica, iron, manganese, and copper, possess the chemical character of bases, while chlorine and the three acids operate as combining and neutralizing powers; so that many salts of a nature to exert distinctive and even energetic manurial action may be formed,—particularly sulphate of soda, sulphate of magnesia, chloride of sodium or common salt, bone-dust, or phosphate of lime, alum, copperas, gypsum, and a kind of bone-dust, salt of iron, or phosphate of iron. Some of the salts derivable from the combination of the bases and the acids, such as the compounds of potash and soda with chlorine, silica, carbonic acid, and sulphuric acid, are soluble in water; while others, such as the compounds of lime, and one or two of the other bases, with silica, carbonic acid, and phosphoric acid, are insoluble. More than one-half of the entire bulk of the ashes consists, in very many instances, of carbonate of lime. The quantity or proportion of ashes, obtained from plants which have been dried in the air, varies from $1\frac{1}{2}$ to $3\frac{1}{2}$, and even 6 per cent. of their weight, and is affected, not only by the genus or species of the plants, by the aggregate amount of their exposure to the sun, and by the character of the soil in which they grew, but also by the peculiar secretions or constitution of the different parts of individual plants, and even by accidental circumstances in the same part of two plants of one species.

Very carefully dried specimens of plants and parts of plants, of the kinds most commonly cultivated, were analyzed by M. Boussingault, and ascertained to contain a percentage of ashes as follows:—wheat straw .070, wheat .024, rye straw .036, rye .023, oat straw .051,

oats '040, potatoes '040, beet-root '063, turnips '076, Jerusalem artichoke '060, stems of Jerusalem artichoke '028, white pease '031, pea straw '113, clover hay '077, meadow hay '090, and meadow aftergrass '100. The ashes of various plants and parts of plants were analyzed by M. de Saussure; and the results, in a few cases, were as follows:—the ashes of chestnuts contain '120 per cent. of earthy phosphates, '280 of phosphate of potash, '030 of sulphate and chloride of potash, '510 of carbonate of potash, '005 of silica, and '003 of metallic oxides; the ashes of buckbean in flower contain '150 per cent. of earthy phosphates, '120 of sulphate and chloride of potash, '572 of carbonate of potash, '050 of earthy carbonates, '020 of silica, and '005 of metallic oxides; the ashes of buckbean, cleared of seed, contain '060 per cent. of earthy phosphates, '020 of sulphate of potash, '140 of chloride of potash, '310 of carbonate of potash, '370 of earthy carbonate, '028 of silica, and '007 of metallic oxides; the ashes of beans contain '259 of earthy phosphates, '439 of phosphate of potash, '020 of sulphate of potash, '009 of chloride of potash, '225 of carbonate of potash, and '005 of metallic oxides; the ashes of wheat straw contain '062 per cent. of earthy phosphates, '050 of phosphate of potash, '020 of sulphate of potash, '030 of chloride of potash, '125 of carbonate of potash, '010 of earthy carbonates, '615 of silica, and '010 of metallic oxides; the ashes of selected wheat contain '445 per cent. of earthy phosphates, '320 of phosphate of potash, mere traces of sulphate of potash, '002 of chloride of potash, '150 of carbonate of potash, '005 of silica, and '002 of metallic oxides; the ashes of wheat bran contain '465 per cent. of earthy phosphates, '300 of phosphate of potash, '002 of chloride of potash, '140 of carbonate of potash, '005 of silica, and '002 of metallic oxides; the ashes of Indian corn-straw contain '050 per cent. of earthy phosphates, '097 of phosphate of potash, '013 of sulphate of potash, '025 of chloride of potash, '590 of carbonate of potash, '010 of earthy carbonates, '180 of silica, and '005 of metallic oxides; the ashes of Indian corn contain '036 per cent. of earthy phosphates, '475 of phosphate of potash, '002 of sulphate of potash, '003 of chloride of potash, '140 of carbonate of potash, '010 of silica, and '001 of metallic oxides; the ashes of barley straw contain '078 per cent. of earthy phosphates, '035 of sulphate of potash, '160 of carbonate of potash, '125 of earthy carbonates, '570 of silica, and '005 of metallic oxides; and the ashes of barley in the husk contain '325 per cent. of earthy phosphates, '092 of phosphate of potash, '015 of sulphate of potash, '003 of chloride of potash, '180 of carbonate of potash, '355 of silica, and '003 of metallic oxides.

The constituent ingredients or elementary combinations of ashes, as we already hinted, are not in the condition in which they existed before incineration. Certain organic acids constantly exist in plants, and are generally in combination

with alkaline mineral bases, particularly with potash, soda, lime, and magnesia; and, in the process of incineration, these acids are destroyed, and the bases which were combined with them are let loose, and enter into combination with carbonic acid to form the carbonates of the ashes. The phosphates, the sulphates, and the chlorides, however, possess the power of resisting a high degree of heat, and pass without change into the ashes from the plant.—But when vegetable ashes, as in many parts of America, are obtained in large quantities, and subjected to the process termed leaching for the preparation of ley, they are deprived of nearly all their potash and soda, and of all their acids except the phosphoric. The residue of this process, therefore, or what are termed spent ashes, are fearfully deteriorated as a manure, and owe all their strength to their small portion of bone-dust salts, and their vestiges of potash and soda; and they ought never to be used on a wet soil, but always scattered over light, porous, open sandy ground. Yet all vegetable ashes derive their chief manurial value from their alkalies, and when intended to be used for fertilizing soil, ought always to be protected from every process or exposure which might deprive them of any portion of their alkaline properties.—One important lesson from the saline composition of vegetable ashes is, that a substitute for them as fertilizers may be, more or less, found in almost all the cheap and common salts of commerce. "In fact," as Dr. Dana remarks, "almost all salts which occur in a large way, as refuse materials from manufactures or other sources, have been used, and all with greater or less success, as manures. And if you cast your eye over the acids and bases of common ashes, this seems quite reasonable. It is not expected that a plain farmer, possessing little or no chemical knowledge, should be able to tell beforehand what the effect of a salt would be, applied to his land; but if he understands what the composition of ashes is, he may be sure that in any quantity in which the salt is likely to occur, it cannot be injurious, provided it is mixed up with plenty of mould, and a little ashes or alkali, which will kill or neutralize any excess of the poisonous acid." See articles SALTS, ALKALIES, ACIDS, and MANURES.

Wood Ashes.—The ashes of timber, or of the billets, branches, and spray of timber trees, are of vast importance as manures, both because of their superior alkaline wealth, and on account of the comparative abundance in which they are obtained from fuel. The farmers of some parts of Germany esteem them of so great value as to procure them from a distance of 18 or 24 miles; and many farmers of the inland counties of England, where wood is the principal article of fuel, contract with cottagers around them for all the ashes they accumulate, and pay them wholly or partially by drawing home for them faggots in return. Wood ashes, when lixiviated with cold

water, contain silicate of potash in exactly the same proportion in which it is contained in straw; they also contain considerable quantities of phosphates,—those of oak 4 or 5 per cent., those of firs and pines from 9 to 15 per cent., those of hazel 12 per cent., those of poplar $16\frac{1}{2}$ per cent., and those of beech about 20 per cent.; they give to the soil out of every four hundred pounds of their weight from oak, or out of every one hundred pounds from beech, as large an amount of phosphates as is yielded from every 460 pounds of fresh night soil; and they, in consequence, not only correct or neutralize into useful salts a large proportion of any acidity which may exist in even the sourest land, but vigorously exert the very same manurial power which is possessed by farm-yard dung, or by the richest composts. A serious practical error, however, is, that almost all farmers employ wood ashes without any discrimination of the sorts of timber from which they are obtained; and an important theoretical error into which the discriminating few are liable to fall is, that the comparative superiority of different kinds of ashes depends more upon the proportion of phosphates than upon that of potash. Trees of different genera, and even of different species, differ widely from one another in the proportion of potash which they yield by incineration; and were they classified and always estimated according to that proportion, and those yielding large quantities of potash burnt separately from those yielding small quantities, farmers would be able to make both a more judicious and a more economical application of their ashes to the soil. Trees, in a general view, make a plentiful yield of potash, somewhat in the degree of their hardness, their heaviness, and the closeness of their texture; and the chief of them may, upon this principle, be distributed into four classes,—first, the oak, the ash, the yew, the beech, the chestnut, the pear, the crab, the blackthorn, and the broom,—second, the elm, the maple, the hornbeam, and the whitethorn,—third, the pines and the firs,—and, fourth, the birch, the alder, the poplar, the hazel, the alder, and the willow. When six loads of the ashes of the first class are sufficient for an acre of land, ten or twelve loads of the ashes of the fourth class may be required; and when twelve loads of the fourth class have been used with good effect, twelve or even ten loads of the first class might, in a dry season, exert so caustic an influence as to destroy or at least seriously damage the crop. Ashes of furze obtained from respectively the lime-kiln and the brick-kiln, ought also to be estimated and employed in the same proportional manner as the ashes of different classes of timber. A considerable portion of the limestone in the lime-kiln, and of the clay in the brick-kiln, is calcined and reduced to powder by the action of the fire, and falls to the bottom, there to mix with the ashes of the furze faggots; and just in the degree in which calcined lime is a more

powerful stimulant than burnt clay, ought the proportion of matter mixed with the ashes in the lime-kiln to be estimated above the proportion mixed with them in the brick-kiln. Every farmer, in fact, ought to ascertain as closely as possible the comparative alkalinity and causticity of the kind of wood ashes he employs, and both to proportion the quantity and modify the uses of the manure according to its power. He who treats all wood ashes alike is always a spend-thrift, and occasionally a depredator.

Peat Ashes.—The ashes of peat, dried bog, decayed and fossil moss, or the lower strata of morass-turf, differ very widely in general chemical character from those of wood ashes, and yet are scarcely, if at all, inferior in importance to agriculture. They possess great adaptation and value for turnip fields, sour meadows, and all kinds of artificial grass lands, principally applied as a top-dressing; they are prepared in large quantities in various parts of England, especially at Newbury in Berkshire, for the uses of the farmer; and they are very extensively made in Holland, for general use throughout that kingdom and Belgium, and even for exportation into Great Britain and other countries. They owe their fertilizing power—not like wood ashes, to potash and the phosphates—but principally to gypsum or the sulphate of lime, partly to carbonate of lime, partly to calcareous and aluminous earths, and subordinately to small quantities of the sulphate of potash, and the chloride of soda or common salt. Sir Humphrey Davy found that the peat ashes of Newbury contained from 33 to 25 per cent. of gypsum, that those of Stockbridge in Hampshire contained a still larger proportion of gypsum, that those of Wiltshire contained a considerable proportion of gypsum, and yet that those of various districts in Wales, Scotland, Ireland, western England, and northern England, contained no such quantity of gypsum as could be useful, but abounded in oxide of iron, and in silicious and aluminous earths. He remarks, however, that “vitriolic matter is usually found in peats; and if the soil or substratum is calcareous, the ultimate result is the production of gypsum.” The existence of even a comparatively small proportion of oxide of iron in any peat ashes instantly reveals itself to the eye by the redness of their colour. The ashes of some Irish peat contain a noticeably large quantity of sulphate of potash. The ashes of some very celebrated peat ashes, brought not many years ago from Holland, were found by Professor Brande to yield 32 per cent. of silicious earth, 12 of gypsum, 6 of sulphate and chloride of soda, 40 of carbonate of lime, 3 of oxide of iron, and 7 of impurities and loss; some peat ashes from Bassy in the department of the Marne, were ascertained by Berthier to yield 26 per cent. of gypsum, $22\frac{1}{2}$ of silica, alumina, and oxide of iron, $51\frac{1}{2}$ of carbonate of lime and magnesia; and some peat ashes from Fichtelgebirge were found by Fiken-

tacher to yield $4\frac{1}{2}$ per cent. of gypsum, $36\frac{1}{2}$ of silica, 17.3 of alumina, 33 of oxide of iron, 2 of carbonate of lime, $3\frac{1}{2}$ of magnesia, $\frac{1}{2}$ of chloride of calcium, and 2.7 of carbonaceous residue.

The bog whence the Newbury peat ashes are made lies beneath good meadow soil, generally about five feet from the surface, in a bed of from one foot to nine feet in thickness, and at such a level below neighbouring hills of chalk as to receive large calcareous depositions from floods or during heavy rains. Peats or squared clods of it are cut, laid out to dry in a similar manner to the peats or turf of the Scottish and Irish bogs for fuel, and, after being thoroughly dried, are burnt upon the spot in such accumulated heaps as usually yield, in each case, a mass of ashes two or three yards deep, and seven yards in diameter; and the ashes are then sifted, and conveyed away in covered carts to sheds, to be there kept perfectly dry till they are wanted for the land. Slow combustion is found to produce a larger proportion of alkali than rapid combustion; and the storing of the ashes is found to maintain their manurial powers in a vastly stronger and more active condition than if they were exposed to the weather. The proportion of ashes yielded by any quantity of peats is seldom equal to one-fourth of their bulk, yet occasionally amounts to two-fifths, and has even been known to amount to twelve parts in thirty-five. The ashes are usually employed at the rate of from 12 to 15 bushels per acre of turnip or clover land, and from 18 to 20 bushels per acre of meadow-land; when used for top-dressings, they are applied in March and April; and when otherwise used, they are either spread on the land in autumn, or more generally with the sowing of the seed in spring. They are a poor manure for corn crops; they answer well for turnips in wet seasons, and are believed to act beneficially against the turnip fly, but, in dry seasons, are apt to give the crop a burned appearance; and they have so powerful an effect upon clover as to increase the produce of it nearly a ton per acre above the ordinary yield; but they maintain a vigorous action during only two seasons, and then almost totally cease to have influence. They require to be spread in perfectly calm weather; and one man, with a double cart, can manure several acres with them in one day. Some inferior kinds are sold at threepence per bushel, and the best kinds are sold at sevenpence.

The peats cut in Holland for fuel, in the same manner as those in Great Britain and Ireland, burn easily, but yield a whitish kind of ashes which are of little use as a manure. But from the bottom of the pools or ditches which are made by cutting these peats, soft or mud bog is fished up with hooped bags at the end of long sticks, and is poured on the adjacent ground to be drained of its water; and, after being consolidated by a few days' exposure to the air, it is cut into pieces of the size of building bricks, and

dried for use as fuel. The ashes obtained from it are the Dutch ashes which have for about half a century been celebrated as fertilizers; and they are obtained in the ordinary course of the consumption of fuel, and carefully gathered into carts which go the round of the cottages and other houses in which the mud-prepared peats are used. Peats of apparently quite the same kind—manufactured out of the bog mud at the bottom of cut bog-holes, and possessing a blackness, a hardness, and a semi-mineral fracture almost like the soft kinds of coal—are extensively made in several districts of Ireland, and, if properly inquired into and economized, might probably be found to yield quite as good ashes as those of Holland. In Belgium, where the Dutch ashes are in general request as a most valuable or even indispensable manure, they are used for nearly all fertilizing purposes in both the garden and the field. They are scattered over the surface of gardens, after the plots and beds are sown and raked; and they are found to act beneficially on nearly all the kinds of culinary vegetables. They are applied to hops, in the manner of a handful to each plant. They are sown on clover, wheat, and pastures in March and April; on oats and beans, in the beginning of May; and on rye, in October and November. When given to clover, they are distributed in a proportion which corresponds, in our measures, to 19 bushels per acre; and when applied to grain, they act partly in accelerating its early growth, but principally in increasing its quantity. In Holland, the ashes are used in the proportion of about 20 bushels per acre; and after the reaping of wheat and the harrowing of the ground, are strewed upon clover which was sown with the wheat in spring; and they are thus applied in the wheat and clover season of a rotation which consists of potatoes, rape, pease, wheat, clover, and oats. An eminent Dutch agriculturist, F. L. W. Brakkel, commends this method of using the ashes as highly advantageous; but another agriculturist, J. R. Schwarz, says that they ought to be used in a dry state, and thinly strewed, and that, on ploughed land, they ought to be harrowed in before or at the time of sowing. The Dutch ashes began to be somewhat extensively imported to Leith about the year 1833, and to be sold there at a total charge of £3 per ton, so as to be available for manuring lands in the vicinity of that port at the cost of about £1 per acre. Mr. John Mitchell of Leith, who in that year introduced them to the notice of Scottish farmers through the medium of the Highland Society's Transactions, says, "The Dutch ashes require no previous expense or preparation in this country, but can be immediately applied after being landed; whereas bones and rape cake have to undergo the process of grinding before they are fit for use. As a top-dressing, these ashes are superior to common manure, it having been found, on making comparative trials in Flanders, that the crops of clover where the ashes were used, were much

earlier, heavier, and superior in every respect to those which had undergone a top-dressing of horse and cow dung. As a top-dressing to the second crop of clover, they will be found highly advantageous, as by being used this way, they wonderfully increase the rapidity of growth and produce. One of the best proofs of their usefulness is the fact, that while we have frequently in this country very backward and light crops of clover and grass, in Flanders, where this top-dressing is used, such a defection seldom if ever occurs. They are therefore likely to be of great use to the farmer on the lands which have grown sick of clover; and the importance of having a good crop of clover is the more obvious, when it is considered that, in general, the succeeding crop of wheat is only good when the preceding crop of clover has been so. Besides fertilizing the land, the ashes may be of great advantage in preventing the injuries arising from worms or insects; and will no doubt be highly useful as a top-dressing, if regularly persevered in for a certain time, in destroying the mosses and lichens so apt to injure the lawns and natural pasture in this country."

Turf Ashes.—Turf ashes, as distinguished from those of peat, are the residuum of the burning of sward, and are usually obtained by the process so well known under the name of paring and burning. See article *PARING*. They not only differ widely in chemical constitution from any purely vegetable ashes, and necessarily contain a large proportion of the mineral constituents of the incinerated sward, but also vary exceedingly and constantly in themselves according to both the vegetable and the mineral nature of the particular sward from which they are obtained. If the soil of the sward be very sandy, the ashes are very silicious and of little or no value; but if the soil be calcareous or argillaceous, they consist to a great extent of calcareous and aluminous bases, in combination with various acids, and often contain a large proportion of oxide of iron. Yet, as a whole, they are very indeterminate in character, and are fitted to perplex both the agricultural chemist and the practical farmer. Those of light weight are usually much superior to those of heavy weight; those of a soft, flaky, crumbling, and very finely pulverulent kind, somewhat resembling pure vegetable ashes, are in all cases valuable; but those which are gritty and of a very reddish-brown colour, evincing by the one quality the predominance of silica, and by the other the presence of much oxide of iron, are usually little better than sheer poison to the soil.

A specimen of turf ashes, expressly burnt for the purpose, was analyzed by Sir Humphrey Davy, at the request of the Board of Agriculture, and may afford guidance respecting all turf ashes of similar origin and appearance. The turf from which they were obtained was formed and cut upon a chalk soil in Kent, and was taken partly from the outside and partly from the inside of a

heap, in order that the specimen might be of average character. The ashes produced from an acre of the land amounted, when dry, to 2,660 bushels or a little upwards of 77 tons; they were in the form of small lumps, from the size of a pea to that of a hazel nut; they were soft and easily broken, and had neither taste nor smell; and most were of a reddish colour, some were black or blackish-brown, and a few were white. When treated with acids, a considerable portion effervesced; when treated with pure water, they did not yield to the liquid any alkalinity; and when first heated to redness with powdered charcoal, and afterwards treated with diluted acid, they emitted a smell of sulphuretted hydrogen. Two hundred grains of these ashes contained 80 grains of carbonate of lime, 11 of gypsum, 9 of charcoal, 3 of saline matter, principally sulphate of potash and muriate of magnesia, 15 of oxide of iron, and 82 of insoluble earthy matter, principally alumina and silica. Another specimen of ashes was analyzed from the turf of a soil in Leicestershire, composed of nearly three-fourths of sand, and one-fourth of clay, with about 4 per cent. of chalk; and 100 grains of this specimen contained 82 grains of sand, clay, and chalk, 9 of oxide of iron, 6 of charcoal, and 3 of saline matter, principally common salt and sulphate of potash. A third specimen of ashes was analyzed, from the turf of a strong clay soil in Cornwall; and 100 grains of this contained 81 grains of clay and sand, 2 of chalk, 7 of oxide of iron, 8 of charcoal, and 2 of common salt and other saline matter.

Straw Ashes.—The ashes of straw, though figuring as manure in some valuable agricultural treatises, ought, with all speed and decision, to be banished from the nomenclature of manures. Ashes can, in any circumstances, be obtained from straw, only with enormous loss of true manurial matter, and with not a particle of real gain. Straw which has been thoroughly dried at a high heat, yields only 4.02 per cent. of ashes, and consists, in addition, of 46.37 per cent. of carbon, 5.68 of hydrogen, and 48.93 of oxygen. No matter how rich the ashes may be in the most fertilizing salts, the loss of substance for farm-yard manure, in the driving away of so much carbon and oxygen, is far greater than these salts can possibly compensate. Advantageous experiments which have been made of burning the stubble of corn-fields as preparation for clover, owe all their true value to the destruction by fire of the rudimental forms of insects, and of the seeds and foliage of weeds; and in the degree in which they have been effectual, they have required the stubble to be long, in order to give the fire full power, and have proportionally withheld from the farm-yard the substance which forms the chief bulk of its most valuable manure. On the wolds of Lincolnshire, indeed, the very straw of thrashed grain has, in some instances, been largely burnt for manure, and is reported to have, in some comparative trials, been found

superior to farm-yard manure, in the proportion of five tons of the straw to ten tons of the manure; but either some egregious mistake has been committed in the report, or some enormous oversight was made in the experiments; for the assertion, or the alleged general principle, that the reduction of straw to ashes produces more fertilizing power than the employment of it in the usual manner for farm-yard manure, is simply an absurdity.

Soap-Boilers' Ashes.—Soap-boilers' ashes, in the days when kelp and barilla were in universal use, formed a manure of considerable importance, but of disputed, ill-understood, and somewhat peculiar mode of action. They consist of the insoluble parts of the kelp, barilla, or other coarse alkaline matter used in soap-making, mixed with carbonate of lime, common salt, other saline substances, and a considerable proportion of cinders. The insoluble portion of barilla consists principally of carbonate of lime, charcoal, silica, and oxide of iron; and the insoluble portion of other alkaline matters used by soap-boilers, usually consists of the same ingredients and some phosphate of lime. Soap-boilers' ashes are most useful upon peat-moss, cold wet pastures, strong, cold soils, and, in general, upon whatever kinds of land are most benefited by large additions of lime and chalk. About sixty bushels per acre are suitable for turnips, to be harrowed in with the seed; six loads per acre, for wet grass lands; seven loads per acre, for wet arable lands; ten loads per acre, for poor loamy land; and, in general, nearly as large a quantity as common quick-lime, for any purpose of general improvement.

Coal Ashes.—The ashes of coals very considerably vary in character, according to the chemical constitution of the particular coal from which they are obtained. The ashes of anthracite, or almost entirely carbonaceous coal,—the ashes of flaming and caking coal, or of such as is in a very large degree bituminous,—the ashes of cannel or shining coal, or such as is employed in the manufacture of the carburetted hydrogen of the gas works,—the ashes of earth-coal, or such as contains a large admixture of shaly, stony, and argillaceous matter,—the ashes of sulphurous coal, or such as is much impregnated with sulphur,—the ashes of metalliferous coal, or such as contains a very sensible proportion of iron and other metallic ores,—the ashes of not a few varieties of coal, intermediate in character among most of the chief or specific kinds,—all these ashes necessarily differ much from one another in constitution, and exert a very different influence upon the soil. Yet coal ashes may, in a general view, be characterized as containing a large proportion of earthy and metallic cinders, and a considerable proportion of carbonate of lime and sulphate of lime, and as exercising upon the soil an influence accordant with the nature of these ingredients.

Most coal ashes are mixed with the numerous refuse matters of towns, and reach the farmer

only as one ingredient of what is usually designated police manure. Yet though the compost to which these belong must be fully noticed in our article on Composts, we may here advert to the general fact that, whenever it contains a large proportion of coal ashes, it seriously and rapidly deteriorates the proper mechanical action of all light and porous soils. Hard porous masses of matter, or firm irreducible cinders, are formed, in the process of combustion out of all the portions of coal which are strongly impregnated with iron and other metallic ores; these cinders possess the power of absorbing a considerable quantity of fluid; and when they are mixed with the soil, they become saturated with soluble organic matter, the most valuable portion of the food of plants, and, in consequence, completely withhold it from serving its great purpose of vegetable nutrition. This food of plants, indeed, is subject to be partially washed out of the cinders by heavy rains; but, even in the degree in which it is thus returned to the soil, it wants both equal diffusion and steady action, and, at the same time, may be totally unavailable at the precise periods of the plants' growth when its agency is most required. The cinders, besides, are altogether infertile in themselves, and quite irreducible to a fertilizing condition; and they consequently act in mixation with light soil, both as diluents of its strength and destroyers of its slender cohesion. They might appear, indeed, to have a serviceable adaptation to strong clayey soils, which require to be diluted in their aluminous power, and diminished in their cohesive resistance; but unfortunately the fertilizing ingredients which usually accompany the cinders in police manure, are ill suited to clay, and best adapted to sands and very light loams.

Coal ashes, in an unmixed condition, serve as an excellent top-dressing, on clayey lands, for lucern, red clover, sainfoin, and other forage crops; and, when they happen to abound in gypsum and to be comparatively free from cinders, they are suitable, on most soils, for turnips. They are also very serviceable, as a coating or surface-covering in the garden, to prevent the depredations of mice; and if spread over a sowing of early pease to the thickness of from a quarter of an inch to half an inch, they will stimulate the crop to an earlier maturity, by several days, than in most other modes of culture. They are usually employed in gardens either for protecting from mice, or for forming walks, or for increasing the porosity of clayey soil; and, when employed as a manure, they are generally applied in too large quantities, and in consequence have been hastily pronounced hostile to various herbs and trees, which their moderate application would rather serve than damage.

Bone Ashes.—Berzelius, in analyzing the bones of oxen, found that they yielded 66·7 per cent. of ashes, and that the constituents of this percentage were 57·35 of phosphate of lime, with a little

fluoride of calcium, 3·85 of carbonate of lime, 2·05 of phosphate of magnesia, and 3·45 of soda, with a very little chloride of sodium. The ashes of the bones of men contain about 4 per cent. less of phosphate of lime, and nearly $7\frac{1}{2}$ per cent. more of carbonate of lime than the bones of oxen. The incineration of bones differs widely from the incineration of vegetables in effecting chemical changes during the process of combustion; for, with the exception perhaps of phosphate of magnesia, all the ingredients in the ashes of bones exist in exactly the same condition in the ashes as in the bones. Yet bones burnt till quite white, and recently heated to redness, absorb $7\frac{1}{2}$ times their volume of pure ammoniacal gas. Animal ashes, under the name of bone ash, are sometimes employed as a manure; but they have less fertilizing power than ground unburnt bones. See article **BONE-MANURE**.

Clay Ashes.—Various burnt and calcined preparations are extensively employed in England as top-dressings and manures, under the name of clay ashes; and though more the products of calcination than proper incineration, they require, on account of their popular name, to be here fully noticed. Many, perhaps most, of these preparations, differ from the ashy and calcined products of paring and burning, only in their raw material being taken from ditches, banks, hedge-rows and waste grounds, and in their true ashes being smaller in quantity, and less saline in constitution. Whenever the raw material has any kind of sward, the clay ashes obtained from it are substantially the same thing as the turf ashes which we noticed in a former section of this article; whenever the raw material is a sandy or loamy earth, intermixed with weeds and roots, the 'clay ashes' obtained from it owe their chief value to the portion of vegetable ashes yielded by the roots and the weeds; and whenever the raw material is chalky earth or true clay, with scarcely any vegetable intermixture, the clay ashes are sheer calcinations, and owe their fertilizing power partly to mere mechanical action upon the soil, and partly to the mineral alkalinity of their calcareous or aluminous nature. The practice of preparing these clay ashes as manures has been long and extensively prevalent in Suffolk, in Yorkshire, and in other districts; it is highly recommended by several eminent practical agriculturists, who have inquired into its merits; and yet it does not seem to have been very scientifically examined, nor is it practically reported upon with a sufficient precision of terms to afford proper guidance for its adoption in districts where it has been hitherto unknown. The Suffolk method of this practice, though differing in some unimportant particulars from that of other counties, may be regarded as a model. "This method is to dig old borders, surfaces of banks, &c.; turn it over, and, when dry, cart it to a heap and burn; formerly much wood was used, but haulm, straw, dry weeds, and a few

bushes, whins, or anything of that kind may be employed; then build a circular wall of turfs around it, cover the heap slightly with turfs and earth, and set fire to it in several places; feeding with the most inflammable materials at first, afterwards clay or any earth will burn; when all the earth is on the heap, the walls may be pulled down and thrown on, raising it by degrees as the fire ascends, in the shape of a cone, till all is consumed." The ashy and calcined product costs about 16 pence per load, and is distributed over land in the proportion of 50 loads per acre.

Volcanic Ashes.—Some ashes which fell from Vesuvius at Naples in 1822, were of a greyish colour, and without taste, and were found, on analysis, to consist of alumina, oxide of iron, muriate of ammonia, gypsum, potash, copper, manganese, charcoal, and carbonate of lime. Some other ashes ejected from Vesuvius in the same year were in fine powder and grey in colour; when brought to a red heat in a close vessel, they yielded sulphur, but, when brought to a red heat in exposure to the oxygen of the atmosphere, they threw off the sulphur in the form of sulphurous acid; and, upon analysis, they were found to consist of 28·1 per cent. of silica, 18· of gypsum, 20·88 of sulphuret of iron, 8· of alumina, 2·6 of carbonate of lime, 1· of charcoal, and 21·42 of alumina and sulphate of copper, with traces of sulphur, a muriate, and moisture. A glance at the constitution of these ashes explains the peculiar appearance of vegetation around the base and upon the acclivities of both active and extinct volcanoes.—*Dr. Dana's Prize Essay on Manures.*—*Boussingault's Rural Economy.*—*Davy's Agricultural Chemistry.*—*Liebig's Chemistry of Agriculture.*—*Johnston's Lectures on Agricultural Chemistry.*—*Johnson on Fertilizers.*—*Annales De Chimie et De Physique.*—*Booth and Boye's Cyclopædia.*—*Keith's Lexicon.*—*Paper by Dr. Madden in Quar. Journal of Agriculture.*—*The Bath Papers.*—*Malcolm's Compendium of Modern Husbandry.*—*Essay by Mr. Mitchell in Transactions of the Highland Society.*—*Treatise on Flemish Husbandry in Lib. of Useful Knowledge.*—*Museum Rusticum.*—*The Society of Gentlemen's Complete Farmer.*—*Bradley's Husbandry.*—*Miller's Dictionary.*

ASHLAR-WORK. Walls faced with squared stones, and backed with rubble or brick, are called *ashlar work*, and the stones themselves are called *ashlars*. The average size of each ashlar is from 24 to 36 inches in length horizontally, 8 to 12 inches in breadth or depth, and 10 to 16 inches in height. The best figure for the stones of an ashlar-facing is that of a truncated wedge, that is, thinner at one end than the other in the thickness of the wall, so that those in one course may form in their back parts indentations like the teeth of a saw, the next course having its indentations varied from that below it; the whole is therefore toothed or united with the rubble backing, much more effectually than if the backs of the ashlars were parallel with the face. Bond

stones should be introduced in every course of ashlar-facing: they should be in quantity equal to one-sixth of the face of the wall, and of a length to reach at least one foot into the back, but the more the better. Every bond stone should, if possible, be placed in the middle between those in the course below. When the jambs of piers are coursed with ashlar, or when the jambs are of one entire height, every alternate stone next the aperture in the former case, and next to the jambs in the latter, should bond through the wall; and every other stone should be placed lengthwise, in each return of an angle, not less than the average length of an ashlar. Bond stones should have no taper in their beds, nor should their ends, or the ends of the return stones, be ever less than 12 inches. *Closers* should never be admitted, unless they bond at least two-thirds of the thickness of the wall. All upright joints should be square or at a right angle with the face for about two inches back, after which they may widen a little towards the back. The upper and lower beds of every stone should be quite level or parallel to each other for their whole breadth. All the joints, for the distance of about one inch from the face, should be cemented with fine mortar, or with a mixture of oil-putty and white-lead; the former is practised at Edinburgh, the latter at Glasgow; at the latter place the joints of the polished ashlar work are uncommonly fine and accurate. The remainder of the ashlar, and all the rubble, should be laid in good lime mortar; that for the rubble should be made with coarser sand. All the stones should be laid in their natural beds. Wall plates should always be placed on a number of bond stones, to which they may be either joggled or fixed by iron cramps.

ASH-WEDNESDAY. The first day of Lent, a fast forty days long, which the Catholic church orders to be kept before the feast of Easter. It derives its name from the ancient and still existing custom of putting ashes upon the head, as a symbol of humble repentance for sin. It was formerly, and, to a certain extent, is still the custom in Catholic countries, to confess on Ash-Wednesday, to chastise one's self during Lent, and to partake of the Lord's supper at Easter.

ASPALATHUS. A genus of small evergreen, ornamental, greenhouse shrubs, of the pea tribe. Between eighty and ninety species are known to botanists; and about thirty of these have been introduced to Great Britain. The Indian species is a native of the East Indies, and was introduced in 1759; and all the other introduced species are natives of the Cape of Good Hope, and, except in eleven instances, are of quite recent introduction. The galium-like species is an evergreen trailer; and all the other species are evergreen undershrubs, of from $1\frac{1}{2}$ to 6 feet in height, but principally of 2 and 3 feet. The flowers of the Indian species are red; those of the whitish species are white; those of the globular species are orange;

and those of all the other introduced species are yellow. All the flowers are subsessile. Most of the introduced species have their leaves in fascicles or bunches; but four—the silky, the callous, the mucronate, and the long-peduncled—have their leaves trifoliate. Several of the species have a considerable resemblance, in their general appearance, to asparagus, and popularly bear the names of African broom, shrubby trefoil, and narrow-leaved laburnum; and the whole genus was formerly placed by botanists with the robinias or false acacias. The branches of the Indian species are slender; the leaves grow by fives close to the branches; and the flowers grow singly upon long footstalks. The stalk of the silky species is shrubby and ramified; the branches are slender; the leaves are white, silky, and trifoliate; and the flowers are yellow and downy, and grow thinly on the branches. The branches of the earliest-introduced Cape species are slender; the trifoliate leaves are numerous and clustered; and the flowers grow in woolly heads at the end of the branches. All the species are easily raised from seeds; and most may, with a little care, be propagated from young cuttings.—*Hortus Britannicus*.—*Encyc. of Plants*.—*Miller*.—*Marshall*.

ASPARAGINE. The peculiar chemical principle of asparagus. It occurs in the juice of the asparagus leaf and stem, and in that of marsh-mallow and liquorice root; and, on being separated, it becomes crystalline. The crystals of it are hard, brittle, and colourless, and have the form of rhomboidal prisms. Its taste is cool and slightly nauseous. When asparagine is boiled for some time with hydrated oxide of lead or magnesia, it is resolved into ammonia and a distinctive acid called aspartic; and the combinations of this acid with the bases are called aspartates,—and, when the taste of the base does not interfere, they have the taste of the juice of meat.

ASPARAGUS. A genus of perennial plants, of the asphodel family. Thirty-two species have been described by botanists; and twenty-eight of these—one indigenous, and all the others exotic—are cultivated in Great Britain. The common or officinal species grows wild on the coasts of England, and is the well known culinary asparagus of our gardens. Six species—the long-leaved, the bitter, the wood, the whorl-leaved, the maritime, and the Dahurian, from respectively Siberia, France, Hungary, Caucasus, the Caspian Sea, and Dauria—are hardy deciduous herbs; three species—the declined, the decumbent, and Broussonets, the first and the second from the Cape of Good Hope, and the third from the Canaries—are greenhouse evergreen herbs; six species—the climbing, the retrofracted, the stipulaceous, the drooping, the horrid, and the twiggy, from the Cape of Good Hope, Africa, Ceylon, and the south of Europe—are tender evergreen twiners; eight species—the sickle-leaved, the racemose, the Asiatic, the Ethiopian,

the white, the acute-leaved, the leafless, and the Cape, from the East Indies, Asia, Spain, the south of Europe, and the Cape of Good Hope—are tender evergreen undershrubs of about 3 and 4 feet in height; one species—the flexuous, from the Cape of Good Hope—is a tender evergreen climber of 3 feet in height; and two species, *Smithianus* and *plocamoides*, have been quite recently introduced from Teneriffe. About one-third of the species have green flowers, and all the others have white flowers. Some of the species are armed with strong prickles; and on that account give the name *asparagus*, which signifies ‘tearing,’ to the whole genus. One of the species is culinary, seven or eight are ornamental, and all the others are merely curious. An indigenous plant of England has of late years drawn considerable notice, and found its way somewhat extensively to the table, under the name of Prussian asparagus; but it is really the *Ornithogalum Pyrenaicum*, or Pyrenean star of Bethlehem. See the article *ORNITHOGALUM*.

The common or officinal asparagus, *Asparagus officinalis*, concentrates in itself the chief interest of the whole genus. It is one of the most delicate, extensively diffused, and anciently used of culinary vegetables. It is usually boiled and served without admixture, and eaten with butter and salt; or the points of its shoots are cut into small pieces, and served in a manner similar to green-pease. It has too delicate a flavour to be a mere ingredient in compound culinary preparations, or to admit, without detriment, of almost any vegetable accompaniment. The plant is thought to be diuretic, and is extensively employed as an alleviative of stone or gravel by the sedentary operative classes of Paris. It was in high esteem as a delicate esculent among the ancient Greeks and Romans, and it continues to be held in high esteem by a large portion of the modern civilized world. It was much praised by Cato and Columella, and is said to have been highly relished by Augustus Caesar. Pliny speaks of it as growing wild, and as also cultivated to such perfection at Ravenna, that three heads of it weighed a pound. It still grows to an extraordinary size in Asia Minor and on the borders of the Euphrates, and is traditionally, but not very credibly, said to have formerly been so exuberant in these districts, that a man might have stood concealed among its plants. It now grows indigenously on the coasts of many parts of Europe, in some of the fenny districts of England, and in the inland sandy plains of Russia, Turkey, and Greece; and it is everywhere cultivated in gardens,—and, in particular, is cultivated to a very great extent in the vicinity of London, Paris, and Vienna. “In no part of the world,” remarks Loudon, “is it grown to such perfection as in the market gardens around London. That of the parish of Mortlake is particularly strong and succulent: the soil is a sandy loam, deeply trenched, and well manured; the seed is sown in drills and

thinned out till the plants stand six inches apart in the row, and the rows are a foot asunder. Round Paris and Vienna more pains are taken in preparing the soil, by forming excavations, and filling them with layers of turf, durable manure, as bones, wood chips, &c., sand, manure, loam, &c.; but though plantations on such beds last longer than on ours, they do not yield better shoots, and it may justly be questioned whether they are equally profitable to the cultivator.”

The cultivated asparagus is worthless in its English indigenous condition, but is susceptible of remarkably great improvement by culture; and, when well-managed on richly manured, light, and mellow loam, it eventually becomes luxuriant in growth, and very beautiful in appearance. In its wild state, in the fens of Lincolnshire, its shoots are not larger than straws; and in its first cultivated generation from wild seeds, it springs a week or ten days earlier than from garden seed, and is exceedingly sweet, but does not produce shoots of more than one-half of the size of the garden plants. The young sprouting stems, as they emerge from the soil, are used for the table; but when suffered to grow to full size, they form one of the most graceful productions of herbaceous vegetation. The stems ascend and ramify in the manner of exceedingly beautiful miniature trees; the numerous, branching, lateral stalks are covered with innumerable, minute, tufted leaves, of the most lively and delicate green; and at the axillæ or angles of the smaller branches occur two or three greenish, bell-shaped, pendulous flowers. The plant usually grows to the height of about four feet, and blooms from June till August. Each flower consists of a calyx of six deeply cut segments,—six stamens,—one very short style, with its stigma cut into three divisions,—and a germen: and the fruit which becomes developed from the last of these, is a scarlet globular berry, containing in its three cells one or more perfect seeds. The annual shoots for esculent use rise from the roots in the months of April, May, June, and July; and are often obtained in winter, but usually in an imperfect condition, by various processes of forcing. Two principal varieties are in cultivation,—the red-topped, with reddish green, full, and close heads,—and the green-topped, with green heads, not so close and plump as those of the red-topped. Several subvarieties also are in extensive cultivation, and take their name from the places where they were first known, as Gravesend, Battersea, Deptford, Reading, and Cork; but most subvarieties are merely local, and scarcely any can be said to be propagable from seed.

The successful and highly artistic modes of cultivating asparagus, with the view of producing it in full perfection, in the various countries of Europe, are too numerous and complicated to be merely mentioned, much less described. The mode which is now in favour with the most eminent British gardeners, is to sow carefully se-

lected and thoroughly good seed in spring, once in several years for a single plantation; and, when the plants are one year, or at most two years old, to transplant them into permanent beds; and to begin to cut off the annual shoots for esculent use in the third year after transplantation. The seed-beds are usually four feet broad; the transplanted plants are usually in rows, at the distance of 9 inches from plant to plant, and of 12 or even 18 inches from row to row; and sometimes the seeds are sown in the permanent beds, and merely thinned out to the proper distances. The soil, in every case, is as nearly as possible a dry, sandy, light, mellow loam, trenched to the depth of $2\frac{1}{2}$ or 3 feet, and very powerfully manured. A covering of dung or litter is laid over the beds in winter to protect the plants from the frost; and in spring, this covering is raked off the plants and dug into the alleys, and the beds are stirred with a fork in order to increase absorption of heat and air, and the infiltration and ascent of moisture. Plants raised according to this general method of culture will yield shoots in excellent condition from the fifth till the fifteenth or seventeenth year after sowing; and they may be forced a week or two by warm coverings of dung upon the beds, or extensively forced, but with the speedy death of the roots, by lifting the plants, and placing them on dung or tan beds. But some special modifications of this method of culture may be strongly recommended, and are fitted to render it eminently efficient in relation both to natural growth and to forcing. Mr. Towers, who gives it a decided preference over all other modes of culture, and strongly insists on these modifications of it, remarks that this method is "more novel and perhaps more scientific than other modes, as it may be made to conform to the hypothesis of radical exudation, so that any gardener who practises it can introduce other vegetables between every row of his asparagus, and thus avail himself of the nutritive matters which their radical processes yield to the soil."

The preparation of the bed for this method, fully more than even for the old methods, is a matter of very high importance. An asparagus bed is not made for a single season; but if well laid out and properly planted, lasts for many years, and amply repays considerable cost and unusual labour in its formation. If the garden do not contain light, loamy, mellow soil, two feet deep, and incumbent upon a porous substratum, the whole plot must be artificially formed by the wheeling away of the native soil to the depth of two feet, the imparting of porosity to the subsoil by picking or admixture, and the filling up of the vacuum to the depth of two feet with transported and prepared soil. The most suitable material for the last of these purposes is the turf or sward of sheep-walk or natural pasture, pared $1\frac{1}{2}$ inch thick from a pulverulent or unstoned and irretentive base, and broken, digged, turned and exposed

till it perfectly pulverizes into a rich light earth. The plot selected for the bed may measure about 30 feet in length and 10 feet in width; and it ought to lie fully exposed to the south, in order that the sun's rays may play as freely as possible over its whole surface. If the native soil be of suitable quality, let the gardener open at one end of the plot a trench two feet wide, and wheel the soil from it to a spot two or three feet beyond the other end of the plot; let him dig this trench, and every succeeding one to the depth of not less than two feet; let him clean out the bottom of each trench, and place upon it a good six inch layer of rich manure; let him have immediately adjacent to the plot at least six cart-loads of well-wrought leaf-soil, sea-weed, or perfectly good spit dung; let him assign a fair proportion of this to each trench, and mix it thoroughly with as much of the soil for the filling up of the trench as will raise the surface six inches above the original level; and let him thus proceed, trench after trench, filling the whole space with moved and completely mixed materials, and employing the soil dug out of the first trench for the filling up of the last. If the native soil be unsuitable, the only differences in the process will be the total removal of the native soil from the plot, the use of the carried and prepared soil in its place, and the employment of only three cart-loads of manure for the bed instead of six. In order at once to equalize the surface, to improve the mixation of its materials, to increase its capacity for aeration, and to promote the slow fermentation or eremacausis of its vegetable contents, the whole bed, about a week after its formation, ought to be first sprinkled with about a gallon of common salt, and then dug from end to end in the contrary direction to that in which it was trenched. The bed ought if possible to be brought into this condition during the dry weather of winter, yet may quite advantageously be brought into it during the month of March. "After the ground shall have settled for a week, two beds, each three feet wide, should be marked out; and this width will admit of an alley between the beds, and one on each side of them, more than a foot in breadth. To form these, strain a line on the outside of the beds, and two down the middle space between them, so as to mark out the limits of the beds, and throw the earth out of the alley upon the beds, that their surface-level may be six inches above the base of the alleys. If turf be at hand, it would be right to place three inverted well cut turfs the whole length of the alleys, and thus to form good and solid walks; a dressing of salt should then be sprinkled over the turf to prevent the growth of the grass. Some persons use a deep layer of ashes; but whatever be the material employed, the beds ought to be raised a few inches above the walks,—not, however, to provide for drainage, but to render the future culture convenient, and to give a finished appearance to the plantation."

In fine weather, early in April, let the seed be sown. Though most seed will remain good during three or four years, either seed from bad berries or seed rather long kept, will not produce one plant from twenty grains, and ought therefore not to be employed. The sower cannot be too particular respecting the soundness and excellence of the seed; and if he have not had the means of gathering it within two seasons preceding from plants of his own, he ought to procure it from some brother-gardener or conscientious and practical seedsman, on whose knowledge of its origin and perfect honesty in dealing he can fully rely. Or if compelled to use seeds of unknown age or character, he must at least test their probable vitality in some of the ways which shall be recommended in our article upon SEEDS. The object which dictates and controls the detailed arrangements of sowing, is to obtain one good plant at the distance of every nine inches in a row; and this object will guide every gardener of tolerably good sense, far better than a code of minute directions. Yet we may say, in general, that three drills should be formed along each bed, at the distance from one another of a foot; that each drill should be an inch and a half deep, and should be made smooth and even along the bottom, by the pressure of the long handle of a rake or of any similarly-formed straight pole; and that the seed, if undoubtedly good, should be dropped in threes or fours, about an inch asunder from each other, at every space or distance of nine inches,—but if of doubtful quality, ought to be sown along the whole drill with a degree of scantiness or profusion corresponding to the supposed proportion of their soundness.

When two young plants rise close to each other, the one should, as soon as possible, be carefully removed; and when they have been thickly sown, and come thickly up, they ought to be very early thinned. Yet previous to a final thinning of nine-inch sowings, or a thinning to two or three inches of continuous sowings, the plants should be permitted to attain a height of three inches and to effect a perfect development of their leaves, in order that the strongest plants may be easily ascertained, and may alone be permitted to remain. Besides, as no man can conjecture what amount of damage may be done by moisture, frost, snow, and other hostile influences during the dormant season, a large stock of young plants, previous to final or severe thinning, ought to be permitted to stand in the drills till the second spring. If the plants suffer little injury from the winter, the supernumeraries can be taken out in spring, and may then be employed in other fashions for the raising of additional crops. But during the whole of the first season, as well as during subsequent years, the spaces between the rows must be kept clean by cautiously passing a Dutch hoe, from time to time, over the surface. Such culture as this, upon mere seed-beds, without any transplanting, has occasionally produced

very good asparagus for use in the course of 25 or 26 months after sowing.

When transplanting from mere seed-beds is practised, or when additional crops are desired from the thinnings of permanent beds, plants of the first year may be planted four inches apart either in shallow trenches or in open drills cut with a spade along very tightly stretched lines, and plants of the third year, or if possible the fourth year, may be employed when esculent produce is desired within the period of twelve or fifteen months. The plants ought to be placed so deep as to permit their crowns to be covered with two inches of fine soil; and their roots ought to be let down expandedly, and in full length, and to be placed in complete contact or coating with the soil. The proper time for transplanting is after considerable drought, and while the soil is open, free, and pulverulent, in March or April; and immediately after planting, each row ought to receive one liberal watering, in order that the plants may be securely fixed, and may as speedily as possible start into growth. If blanks occur in consequence of the decay of some roots, they may, as late as the middle of June, be filled up from the nursery-bed; but the plants used for them must be real seedlings, and must be planted in an evening or during cloudy weather, and copiously watered.

Any bed of asparagus growing in single rows may be set apart for the purpose of forcing; and it may be so contrived as to furnish three distinct forcings,—the first to commence late in November, to be cut at the close of the year,—the second, about the first week in January,—and the third early in February,—while a fourth reserve ought to come in at the natural season, blanched but not forced, in April. After the stems of the plants have become inactive, or have acquired their hybernating condition, they ought to be cut away, the rows should be moulded up with fine soil from the spaces,—the earth of each space on the sides of the rows which are destined to be forced, should be dug up and carried away in such quantity as to leave trenches of one foot in depth,—shallow boxes or troughs, formed of three strips of board fastened together, and five or six inches deep, should be placed invertedly over the rows of the plants,—a compost of two-thirds of tree leaves and one-third of fresh stable manure, should be employed to fill up the trenches to the level of these covering troughs,—either a similar compost, or at least a mass of tree-leaves should be heaped over both rows and trenches to the additional depth of 18 inches or two feet,—and a thatch of straw hurdles or of any similar material, should be placed over all, to keep out excessive rains, and to retain the developed heat. Trial sticks should be thrust into the masses; and if these, on being withdrawn, feel gently warm, the process of regular and successful forcing may be regarded as begun and certain. After the process is completed, and all its objects

achieved, the bed should be cleared of its forcing appliances, and restored to its former condition.—*Loudon's Hortus Britannicus*.—*Maure's Gardener's Calendar*.—*Paper by Mr. Towers in Quarterly Journal of Agriculture*.—*Loudon's Encyclopædia of Plants*.—*Transactions of the London Horticultural Society*.—*Miller's Gardener's Dictionary*.—*Loudon's Gardener's Magazine*.—*The Magazine of Domestic Economy*.

ASPARAGUS BEETLE. See CRIOCERIS.

ASPARTATES. See ASPARAGINE.

ASPECT. A synonyme in gardeners' language for exposure. See article EXPOSURE.

ASPEN or RATTLER,—botanically *Populus tremula*. A species of amentaceous tree, of the poplar genus. It grows wild in the moist woods of England and Lowland Scotland, and on the borders of lakes and rivers in the Scottish Highlands. Its form pleases the eye; its stem is tapering and symmetrical; its young shoots are of a dark-brown colour; its leaves are roundish, angularly indented, smooth on both sides, green above and whitish below, and stand upon long slender footstalks; and its catkins appear in March and April, and resemble those of the abele. It often attains a large size, but usually has a height of about 50 feet. Both of its popular names, and also its specific botanic name, allude to the well known property of its leaves of being freely shaken, and of occasioning a rustling sound, by the slightest current of air. Linnæus and Dr. Stokes ascribe this property to the peculiar structure of the compressed petiole or leafstalk; for the planes of it are at right angles to those of the body of the leaf, which is itself furnished with two glands, running the one into the other. Yet the flattened petiole is common to all the poplars; and the mobility and rustling of the leaves of trees, in general, are in the proportion of the length and slenderness of the petioles. A superstitious opinion is said to prevail in some parts of the Scottish Highlands, that the aspen furnished the timber of our Redeemer's cross, and, in consequence of this, acquired its excessive sensibility to the action of the wind. The tremulousness of the leaves of the aspen, combined with the difference of the colour of their two surfaces, gives the tree a very changeful and somewhat interesting appearance, and entitles it to a place among ornamental wood which could not be obtained for it by its form and habits. Its foliage is interesting in all its stages, from the light green of summer, to the bright yellow of autumn and the vivid red of commencing winter. But the tree is mischievous from its radical habits, and inappreciable in its peculiar beauties, when it stands in the interior of a wood or among a crowd of trees; and it probably produces its finest effect, when growing on the margin of a plantation of firs. Its roots have the same spreading, decurrent, exhausting habits as those of some other species of poplar; and they send up many shoots or suckers at a distance from the stem, and monopolize all

the vegetable nourishment of a comparatively large circumference of soil. The bark is a favourite food of beavers. The timber is very light, white, smooth, soft, and durable in the air; and may be used for the same purposes as the timber of the abele. See ABELE. Red glandular-looking substances about the size of pence may sometimes be observed on the leaves and petioles, and are the nests of a kind of long-legged fly which entomologists call *Tipula juniperina*. The aspen is very easily propagated from suckers, and will grow and flourish in almost any kind of soil except clay.—*Miller's Dictionary*, V. POPULUS.—*Marshall on Planting*, V. POPULUS.—*Sir John Sinclair's General Report of Scotland*.—*Nicol's Planter's Calendar*.

ASPERUGO. A curious, deciduous, procumbent, annual weed, of the borage family. It grows to the height of 3 feet; its stem is climbing and very rough; and its flowers are small, blue, and axillary, and appear in April and May. It grows wild, not only in Britain, but over all Europe, from Lapland to the Mediterranean. Only one species of it, *Asperugo procumbens*, is known; and this is sometimes popularly called German madwort.

ASPERULA. See WOODROFF.

ASPHALT. A native resinous substance found in some quantity on the shores of the Dead sea, on the island of Trinidad, &c., and supposed to be raised by springs from decomposing coal-formations. It is black, shining, fuses at about 212°, burns readily with a white flame and much smoke, leaving little ashes; by dry distillation it yields empyreumatic oil, a little ammoniacal water, and combustible gases, and leaves $\frac{1}{2}$ carbon, containing in its ashes silica, alumina, oxide of iron, &c. It is insoluble in water; alcohol extracts 5 per cent. of a yellow resin; ether extracts from the residue 70 per cent. more of a black or brownish black resin; the portion insoluble in alcohol and ether is readily soluble in oil of turpentine and naphtha, with difficulty in lavender-oil; this last, called by Boussingault *asphaltin*, is black, shining, and softens at 572°. Sulphuric and nitric acids convert a part of asphalt into artificial tannin; potash dissolves a large portion of asphalt with a black colour. The numerous cements in use at the present day under the name of asphalt are very different in their composition. Seyssel-asphalt is a combination of asphalt, and other bituminous substances, with carbonate of lime, in the proportion of about 83 of the former to 17 of the latter. See BITUMEN and PETROLEUM.

ASPHODEL,—botanically *Asphodelus*. A genus of ornamental herbaceous plants, forming the type of the extensive natural endogenous order Asphodeleæ. Thirteen species have been described by botanists, and introduced to Great Britain. The yellow species, *Asphodelus luteus*, is an old and well known inhabitant of our gardens; it was introduced from Sicily in 1596; it is a hardy, perennial, evergreen herb; and it

grows to the height of 3 feet, has a leafy stem, produces yellow flowers in May and June, and admits of easy culture and rapid increase. A deciduous variety of this species, attaining a height of only 2 feet, and producing its flowers in April and May, was introduced from Siberia in 1829. The upright and the onion-leaved species, *albus* and *fistulosus*, are likewise old and well known plants of British horticulture; they were introduced from the south of Europe about the time of the introduction of the yellow species: they closely resemble the evergreen variety of that species in habits and character; they grow to the height of respectively 18 and 24 inches; and one or both overrun vast tracts of land in Apulia, and there afford a valuable subsistence for sheep. The club-seeded species is a tender annual, of a foot in height, introduced from the East Indies in 1808; the proliferous species is a curious hardy annual of 4 inches in height, introduced from Armenia in 1824; the small-podded species is a hardy bulbous plant, the only bulbous one of the genus, introduced from Dalmatia in 1831; and most of the other species and varieties resemble the old-introduced ones in habits and character, and are natives of Tauria, Siberia, Spain, and Candia.—The order asphodeleæ comprises no fewer than 51 genera; and has, within the gardens of Great Britain, about 300 tender and 220 hardy species. A few of its species have arborescent stems, some have fasciculated roots, a considerable number are bulbous, many are very beautiful, and all are at least pretty. The greater portion have so distinctive a character as to be easily recognised; but some cannot, without a knowledge and inspection of minute botanical characteristics, be distinguished from some plants of other orders. They are broadly separated from the rush tribe by their comparatively large and showy flowers,—from the lily tribe, by exactly the reverse character, the comparative smallness of their flowers,—and from the hemerocallidæ or day-lily tribe, by the expansion of their flowers; but they can be distinguished from the colchicum tribe only by the minute character of their style and anthers. One of two great subdivisions of them are represented by the numerous onion genus, and have no true stem, and consist entirely of bulbous species; and the other subdivision are the proper asphodeleæ, and have for the most part clustered fleshy roots.—*London's Hortus Britannicus*.—*The Penny Cyclopædia*.—*Miller's Gardener's Dictionary*.—*Mare's Gardener's Calendar*.—*London's Encyc. of Plants*.

ASPHYXIA. Suspended animation produced by the non-conversion of the venous blood into arterial blood. Owing to the supply of air being cut off, the unchanged venous blood of the pulmonary artery presses into the minute radicles of the pulmonary veins; but their peculiar irritability requiring arterial blood to excite them, stagnation takes place in the pulmonary radicles, and death occurs chiefly from this cause. As-

phyxia of the new-born of any animal is often dependent upon its feeble condition not permitting respiration to be established. Asphyxia by noxious inhalation takes place in some cases by the inhalation of gases, which produce a spasmodic closure of the glottis; in others, by the want of oxygen; and in others by the presence of gases positively deleterious or poisonous. Asphyxia by submersion occurs in the case of drowned animals in consequence of the medium in which they are plunged being unfit for respiration.

ASPIDIUM,—popularly *Shield-fern*. An extensive genus of ferns, of the polypody tribe. About 165 species have been described by botanists; and about 60 of these are either indigenous in Great Britain, or have been introduced from foreign countries, principally the West Indies and America. The name *aspidium* means 'a little buckler;' and both this and the popular name allude to the form of the indusium. Two of the species in Britain have their fronds ternate; thirteen have their fronds pinnate, and their leaves crenate, dentate, or serrated; fifteen have their fronds bipinnatifid; eighteen have their fronds bipinnate; and thirteen have their fronds tripinnate or supradecomposed. Nearly all are ornamental; several are eminently handsome; and only one or two have the character of weeds. The male-fern, *Aspidium filix-mas*, one of the bipinnate kind, is at once the coarsest in form, the most weedy in habit, and the most generally known in character. It is common in woods and shady places in Britain and throughout Europe; it grows to the height of 3 feet, and fructifies from June till August; and its root consists of many matted fibres, which form a blackish, scaly, and turfy or cæspitose head, of the thickness of a man's finger. This plant was used in ancient times and during the middle ages as a specific for worms; it still holds a place, though an obscure one, in such standard pharmaceutical works as Dr. Christison's Dispensatory; and it probably shares with scores of other species of polypodiaceæ, the bad pre-eminence of being 'the polypody,' which some pitiful empirics daringly prescribe for diseases of the stomach and intestines, to the exclusion, of course, of really useful remedies, and the consequent emperilling of the credulous patient. The principal other British species, are the *Lonchitis*, with pinnate fronds, and growing to the height of nine inches on the acclivities of rocky mountains; the *Oreopteris*, with bipinnatifid fronds, growing three feet high on heathy grounds; the *Lady Fern*, with bipinnatifid fronds, growing one foot high in marshes; the *plashy aspidium*, with bipinnatifid fronds, growing one foot high in wet shady places; the *prickly aspidium* and the *lobed aspidium*, with bipinnate fronds, growing two feet high in shady ground; the *dilated aspidium*, with bipinnate fronds, growing two feet high in wet shady places; the *brittle or fragile aspidium*,

a very handsome species, growing nine inches high on walls; the Rhætian and the royal, also very handsome species, growing six inches high on rocks; and the thicket aspidium, a rare and recently-discovered species, growing nine inches high on shady rocks. One of the most remarkable of the exotic species, and indeed of the whole family of ferns, is the celebrated Scythian lamb, the topic of so many fables, *Aspidium Barometz*. "Although," says the editor of the *Encyclopædia of Plants*, "it is often brought in a fresh state to the markets of Macao as an article of medicine, no plants have ever reached this country alive. Its name has arisen from the resemblance which its brown hairy rootstalk bears to a little rufous dog couching; and the belief in its animal nature has been confirmed by the colour of the juice, which is of a rich blood colour, and soon becoming thick by exposure to the air. It is needless to add that the stories about no plant being able to grow near it are mere fables. Kæmpfer says that *borannek* is the name which the people on the borders of the Caspian Sea give to a kind of sheep of that country."

ASPLENIUM,—popularly *Spleenwort*. An extensive genus of ferns, of the polypody tribe. The plants of some of the species were formerly regarded as specifics in all diseases of the spleen; and they derive from this circumstance both their botanic and their popular names. About 160 species are known to botanists; and about 60 of these are either indigenous in Great Britain, or have been introduced from foreign countries. Five or six of the latter have undivided fronds: two have angular, lobed, divided fronds; one has tripinnate leaves; and all the others have either pinnate, bipinnate, or bipinnatifid fronds. The chief of the British species are the maidenhair, growing six inches high on shady rocks; the northern and the sea, six inches high on rocks; the alternate-leaved, six inches high in Scotland; the fountain, often called an aspidium and a polypody, and very handsome in form, nine inches high in England; the lanæolate; the wall-rue; and the black adiantum.

ASS,—scientifically *Equus Assinus*. A well known quadruped, of the horse genus of the thick-skinned class of animals. The variety of ass generally known in Great Britain and Ireland, is of a very inferior character; and affords a very inadequate representation of either the best domesticated varieties of other countries, or the most spirited and symmetrical of the known varieties of the wild ass. Our popular notions of this animal—based principally on contempt, and prompting chiefly to neglect and cruelty—are a gross outrage upon common sense, natural history, and even religious feeling, and are woefully inconsistent with the enlightenment of the nineteenth century, and the boasted civilization of the British people. The ass—except in so far as he is starved and thrashed and half-butchered out of his natural disposition—pos-

sesses scarcely a trace of the disagreeable temper which popular belief assigns to him, and is distinguished by several most useful habits and most desirable properties for which not one Briton in twenty will give him a particle of credit; he figures very anciently, most extensively, and not a little respectably, in the history of the civilized world; he was held in high esteem by several ancient and enlightened nations, whose opinions on most other matters connected with civilization are respected by posterity; he was domesticated and generally useful before either the horse or the dog, and was long retained in the service of the peaceful arts after the horse became subservient to the purposes of war; and, above all, he figures with considerable frequency and with uncommon interest in the Sacred Scriptures, and is there exhibited to us in connexion with one of the most simply sublime and beautifully affecting passages in the personal history of our Redeemer. The Christian who thinks contemptuously of the ass, loses instruction out of various parts of Scripture; the farmer who thinks meanly of him, deprives himself of much profitable service in draught labour upon his farm; and the mere hobnail or schoolboy who sneers at the ass's alleged stubbornness and stupidity is, in the popular use of the word, a greater ass than the animal he despises.

In Western Asia, the ass was domesticated long before the commencement of profane history, and has ever since been held in high esteem, and continues to be carefully bred and reared; yet in Europe, it was little known till a considerable period after the commencement of profane history, and has never, except in limited districts, attained its due situation of consequence. In the time of Aristotle, the ass was unknown in Pontus, in Scythia, and in the great territory which now constitutes Germany and France; and so late as the time of Elizabeth, it was extremely rare in England. Wherever the horse preceded him as a domestic animal, the ass found difficulty in obtaining a fair degree of favour, or even honest consideration of his claims; his inferiority to the horse in size and strength instantly excited strong depreciation, and seems to have originated the unjust contempt in which he continues to be held; and his deprivation of all means for attaining improvements in breed, corresponding to the improvements in that of the horse, has hitherto had the appearance of justifying, in a large degree, his stern exclusion from favour. "He is the sport, the butt, and the drudge of the vulgar, who, without the least thought or concern, drive him along with a cudgel, beating, overloading, and tiring him. We do not remember, that, if there were no horses, the ass would be considered, both with regard to himself and us, as the most useful, most beautiful, and most distinguished of animals. Instead of being the first, he is now the second; and from this accident alone, he is held in no estimation.

It is the comparison that degrades him: he is considered, not in himself, but relatively to the horse. We forget that he is an ass, that he has all the qualities of his nature, all the gifts annexed to his species; and think only on the figure and qualities of the horse which are wanting in him, and which it would be improper for him to have."

The facts respecting the wild ass are, in some instances, ill-authenticated and obscure, and, in general, badly methodized and ill squared with science. Some animals which he calls wild asses were seen by Bruce in Abyssinia. A wild ass is noticed by Bell as an inhabitant of Tartary, having waved white and brown hair resembling that of a tiger; but no such Tartarian wild ass is otherwise known to naturalists. The proper wild ass of Tartary, called *koulán* by the Tartars, and believed to be the origin of the ordinary domestic ass, is of a uniform silvery grey colour, with a broad coffee-coloured stripe extending along the spine, and crossed on the shoulders by a transverse band. The wild ass of Khur or Ghurkhurd in Persia stands ten or twelve hands high; its limbs are beautifully slender; its coat or fur is sleek, and of a reddish colour, passing into silvery grey on the belly and hinder parts; its mane is short and black; and the tuft which terminates its tail is also black; but no band of contrasted colour, as in the Tartarian wild ass and the ordinary domestic ass, passes along the back or across the shoulders. The wild ass of the Himalayan provinces, called by the inhabitants *Kiang*, has shorter ears than the wild ass of Khur, and is in other respects so different as to be obviously a distinct variety. The wild ass of Mongolia and the borders of Thibet and China, called by the inhabitants *Dziguetai*, is prevailingly of a pale yellow colour, passing into white on the under parts, and having a dark chocolate-coloured band along the spine. An animal of the south of Africa is described by Le Vaillant as a wild ass, as having a pale yellow colour, as occurring in large herds, and as called by the Greater Namaquas the white zebra; but it has not been reported on by any traveller except himself, and may not improbably, according to a suggestion of Colonel Hamilton, have been the female of the Isabelline antelope. The wild ass of Cutch and North Goojrat, and the two varieties already noticed as the wild ass of Khur and the wild ass of Mongolia, are thought by Colonel Sykes to be strictly identical with one another; and he suggests that "the discrepancies of descriptions may be easily remedied by the supposition, that animals examined by different individuals, at different seasons of the year, did really slightly differ owing to the difference of seasons." "The wild ass of Cutch and the north of Goojrat," says he, "is not found farther south in India than Deesa, on the banks of the Bunnas river, in lat. about $30^{\circ} 20'$, nor have I heard of it to the eastward of the 75° of longitude on the south side of the Himalaya

mountains. In Cutch and Northern Goojrat, it frequents the salt deserts and the open plains of Thoodpoor, Jaysulmer, and Bickaneer. By swimming the Indus, it may communicate through Scind and Baloochestand with Persia; and in Persia it evidently exists, from Sir Robert Ker Porter's descriptions. To the north and east, Persia abuts upon the peculiar localities of the *Dzegguetai*, through Bucharia to the deserts of Cobi, where it delights in the salt marshes, as it does in India, and thence to Tartary, Thibet, and South Siberia." The Syrian wild ass is both larger and more handsome than the wild ass of Khur; and the species improves to the westward of the Euphrates, becomes very fine on the mutual borders of Asia and Africa, and appears, from the accounts of Burckhardt, to be very abundant in Arabia Petrea. The Tartars hunt the wild ass in preference to all other beasts of chase, and are very fond of its flesh. The Sherarat Arabians also hunt it, privately eat its flesh, and publicly sell its skin and hoofs to the travelling merchants from Damascus. Even the polished and luxurious epicures of imperial Rome held the flesh of the wild ass in the same kind of estimation in which modern epicures hold venison; and Pliny intimates that a sort of regular trade was maintained in supplying the Roman market with ass-foals, of what were reckoned the most delicate and best flavoured kind, from the north of Africa.

Several of the domestic varieties of the ass in other countries than our own, particularly in those of Western Asia, are of a very superior character to our variety, and might be most advantageously imported for crossing and improvement. The foal of an African variety, was not long ago imported to the Surrey Gardens at London, and is known to belong to a race of comparatively great speed and power. Some individuals of a variety reared on the island of Gozo, in the Mediterranean, have been brought to Britain as stallions for the production of mules; and either they or other individuals of the same race, have attained the height of fourteen hands, and been sold for the sum of 100 guineas. Three or four different breeds are raised in Syria, and treated with great care and attention; and one of these is a small but spirited kind, on which the Syrian ladies are accustomed to ride. A domestic breed in Western India are not much larger than good-sized Newfoundland dogs; they are often seen, as frequently the domestic ass of Europe, associated with gypsies; and they are used partly in droves to carry small loads of salt or grain, and partly by pot-makers to carry their clay. But by far the most interesting race, jointly for intrinsic excellence and for extensive distribution, is the ass of Arabia,—which is not only the fostered domestic breed of the country whence it takes its name, but one of the favourite breeds of Syria, Persia, and most other parts of Western Asia. "The asses of Arabia," says Chardin, "are among the finest in the world. Their coat is smooth and

clean. They carry their head elevated, and have fine well-formed legs, which they throw out gracefully in walking or galloping. They are used only for the saddle, and are imported in vast numbers into Persia, where they are frequently sold for 400 livres, and, being taught an easy ambling pace, are richly caparisoned, and used only by the rich and luxurious nobles." An improved and costly domestic breed, used principally for the production of strong, active, and high-priced mules, occurs in Kentucky and other central parts of the United States. Numbers of these are fifteen hands high, and some are sixteen; and all are the offspring of Maltese asses crossed with asses of Spain and the South of France, none of which as imported stood more than fourteen hands high. Instances have recently occurred in America of £250 being refused for a yearling female ass, of a two-year old male ass being estimated at upwards of £600, and of an ass of great celebrity having been sold for £1,000. Yet the average market price of the unimproved, abused, dwarfish ass of Great Britain and Ireland is only about twenty shillings.

The ass, when properly trained and humanely treated, is docile, sagacious, good-tempered, and susceptible of strong attachment to his master; in his natural temper, he is as humble, patient, and quiet, as the horse is proud, fiery, and impetuous; and, though he eventually acquires indocility and stubbornness from injudicious training and brutal treatment, he long resists the natural effects of unkindness, and always, in a high degree, bears chastisements and blows with firmness or even with courage. With regard to both the quantity and quality of his food, he is eminently temperate, often maintaining himself on one-half of what would seem to be sufficient for his wants, and uniformly contenting himself with dry leaves, briars, thistles, road-side forage, and almost any sort of harsh or disagreeable herbs, which the horse and other domestic animals will not touch; but in his drink, he is very nice, using only such water as is perfectly clear, and preferring to drink at portions of limpid brooks with which he has become acquainted. He requires very little management; he sustains hunger, thirst, neglect, and labour, more than most other animals; he is seldom or never sick; and, after hard labour, and as if to save his driver all trouble, he rolls himself on a rough hard road, and rises refreshed and good-humoured. He may be lightly worked, or at least actively trained at two years of age; he is fully able for routine work at three years; and, if tolerably well used, he will continue to labour till the age of thirty. The milk of the female is very light and nutritious, and is used by persons of diseased powers of digestion; and the skin of both the male and the female is peculiarly hard and elastic, and is used for parchment, drum-heads, and other special purposes. The female breeds at two years of age. It is universally known that many ani-

mals will continue to give milk not only after the young are removed, but even for years, when the impression of having had young must have been entirely forgotten. The cow and the goat are instances of this kind; but in the ass the secretion of milk is not continued after the mother has lost the impression of her foal's existence. This is a fact so well known to the keepers of asses, that whenever an ass's foal dies, they take every means in their power to keep up the impression, in the mother, of the foal being still alive, to keep her in milk. For this purpose they take off the skin of the foal and preserve it, so that it may be occasionally thrown over the back of another foal, and smelled by the mother, more particularly at the time they are milking her. The ass, under the deception of having her own foal, gives down her milk, and the secretion is carried on as usual; but if this artifice be neglected she soon goes dry. To ascertain this fact more accurately, the celebrated Mr. John Hunter put it to the test of experiment. He took an ass, in milk, and kept her apart from her foal every night, but had the mother milked in the morning in presence of the foal. This was done for more than a month, without there being any diminution in the morning's milk. The foal was then taken away altogether, and the mother was milked instead of being sucked by the foal, particularly in the evening, at the same hour at which the foal had been taken from her, and again in the morning at the usual hour. The milk taken in the morning was always compared with that taken in the morning before, but in three mornings the quantity was lessened; and the fifth morning there was hardly any. The foal was then restored to her; but she would not allow it to suck. The experiment was repeated with similar results.

The ass, even in his present unimproved condition in Great Britain and Ireland, deserves tenfold more attention from farmers than he has hitherto obtained. On the cabin-farms of Ireland, where the routine-work is greatly too little for the employment of the horse or even of the ox, the services of the ass are very available and in extensive requisition. But even on the large farms of England and Scotland, the ass might, with great saving of care and money to the farmer, be, to a considerable extent, effectively employed instead of the horse. What, for example, should prevent the ass from acting as efficiently as the horse in opening small drills, earthing up cabbages, carting home turnips or rape, going to the mill or the market, turning a churn-wheel, and, in general, performing the numberless kinds of light draught? And if the ass might be as serviceable as the horse in only one instance in ten in which draught-labour is required, what but sheer prodigal waste is it, sanctioned by nothing better than stupid prejudice, to maintain horses for all draught-labour whatever, and not, as far as practicable, to substitute them by the

ass? Or if any farmer cannot, consistently with the economics of his farm, diminish the number of his horses, he might derive considerable benefit to his land and corresponding increase to his profit, by employing an ass or two, with children for drivers, and panniers for means of carriage, in performing some kinds of work, which are at present ill attended to, and for which the horse is not adapted. For example—to adopt the hint and use the words of the Knowledge Society's Treatise on British Husbandry—"the saving of food by weeding may not amount to much in a money calculation, though many herbs thus thrown away would be found palatable if gathered for cattle; but were these animals only employed to remove the weeds from the ground when hoed, it would be of great service, for at least one-half of them strike root again after the first shower, and the remainder, if not eaten, is lost to the dung-heap, whereas that loss would be prevented were they raked up and collected. Their drivers also would be kept employed, which would be found very serviceable to the poor, not alone as an addition, however trifling, to their earnings, but as bringing them up in habits of industry, and as early initiating them into the care of domestic animals, by which their kindness and attention to brutes is found to be very much improved."—*Naturalist's Library*.—*Buffon's Histoire Naturelle*.—*Pictorial Museum of Animated Nature*.—*Proceedings of the Zoological Society*.—*Mortimer's Husbandry*.—*Treatise on British Husbandry in Library of Useful Knowledge*.—*Doyle's Practical Husbandry*.—*Culley on Live Stock*.—*Sproule's Treatise on Agriculture*.

ASSAULT. A term which, in the law of England, signifies an injury violently offered to a man's person. It does not necessarily imply an injury actually done, since a menacing gesture may amount to an assault.

Assault denotes an injury of a more comprehensive nature than *battery*: for the former may be committed by merely offering a blow, as when one lifts up his stick or his fist, in a threatening manner, at another, or strikes at but misses him. And thus assault is defined by Finch (Lib. 202.) to be, "an unlawful setting upon one's person;" whereas, to constitute a battery, there must be an actual beating.

To strike a man, therefore, even should he receive no injury from the blow, constitutes an assault; nay, even the striking at a person, or pointing a loaded gun, or throwing a stone at him, though he should be neither hit nor hurt, has been adjudged to amount to assault. For assault does not always imply, that a blow was actually received; and hence, in action of trespass for assault and battery, the offender may be found guilty of the assault, and acquitted of the battery. If a man threaten to beat another, or lie in wait to do it, whereby that other person is hindered in his business, action lies for the injury.

In an action of trespass and assault, the defendant may plead in justification, *molliter manus imposuit*,—that he laid hands upon him gently, not in anger, nor with any intention of hurting him. A man may justify an assault in defence of his own person or goods; or of his wife, father, mother, or master; or for the maintenance of justice; and the husband, father, or master, may have action of trespass for the assault of the wife, child, or servant; but no words, however insolent and contumelious, will justify an assault, though they may be pled in mitigation; and no provocation which did not take place recently before the assault will justify it.

ASSIGNATION. This word, in the law of Scotland, signifies a written deed of conveyance, whereby the property of any subject not strictly feudal is transferred from one person to another. Even heritable rights, when they are either not perfected by seisin, or when they require no seisin, are proper subjects of assignation.

Assignations are either of debts, as bonds, which are perfected by intimation; or of moveables, which sometimes, though improperly, get the name of dispositions, and are completed by an instrument of possession. The granter of the assignation is called the *cedent*. The receiver, or assignee, is sometimes called in our law style, as he was by the Roman, the *cessionary*. An assignation made over to a third party, is called a *translation*; and, when conveyed back by that third party to the cedent, a *retrocession*.

Assignations are considered as conveyances, by which the property of the subject assigned is fully vested in the assignee; and, in general, he who is in the right of any subject, though it should not bear to assignees, may at pleasure convey it to another, excepting in cases where he is barred, either by the nature of the subject, or by immemorial usage. Such exceptions are: 1. Life-rent rights, of which nothing can be assigned but the profits during the life of the granter. 2. Alimentary rights. 3. Rights which imply a *delectus persone* in the granter, which cannot be transferred without special powers given for that purpose; as the right of an office, of a lease, &c. 4. Paraphernal goods, which are not presumed to be conveyed even in a general assignation by a wife to her husband, unless specially mentioned.

In order to complete the conveyance, it is necessary, not only that the assignation should be delivered over to the assignee, but that it be intimated or notified to the debtor; for the purpose of acquainting him, that he must make payment, not to the original creditor, but to his assignee. And hence, though an assignation not intimated be valid against the granter, who is not permitted to question his own deed; yet if, before intimation of a first assignment, the cedent shall grant a second to a different assignee, the second, if intimated before the first, will be preferred to it. On this ground, also, an assignee cannot plead compensation upon the debt as-

signed, if the concurrence ceased before the assignment was completed by intimation. In like manner, if an assignment be not intimated by the assignee, during the life of the cedent, any creditor of the cedent, who, upon his death, shall confirm the debt assigned, before intimation, shall be preferred to the assignee.

It is not, however, always precisely required, that there should be a formal intimation, attested by a notary: all that the law requires is, either the intervention of some public officer, as a notary, to intimate the assignment to the debtor, or some other notice, which imports intimation as strongly as a notarial instrument. For example, 1st, An action brought by the assignee, or a charge on letters-of-horning, or a citation upon any diligence used by him against the debtor; or, 2d, A promise of payment made by the debtor to the assignee, upon being shown the conveyance; whether the promise be made by a missive, or other proper writing; nay, even a verbal promise, provided it proceeded upon a communing.

The payment of interest, made by the debtor to the assignee, is equivalent to intimation; for it shows the assignee to be in the actual possession of the debt. But the debtor's private knowledge of the assignment is not held equal to intimation. This, however, applies only to the case of a competition among creditors; for when the question is solely between the assignee and the debtor, the debtor's private knowledge of the conveyance puts him in *mala fide* to make payment to the cedent. The assignment of a lease, where not expressly forbidden, or of the rents of an estate, is perfected by possession, without the necessity of intimation; but such assignment, although intimated, is not valid in a competition with creditors, if the assignee has allowed the cedent to remain in possession. Where there are many obligants, intimation made to any one is sufficient for completing the conveyance; but it cannot prevent those, to whom no intimation was given, from making payment to the cedent.

Certain assignments require no intimation: viz., 1. Transmissions, or indorsations, of bills of exchange; among which are included inland bills. 2. Bank-notes, or bank-bills; which are fully conveyed by the bare delivery. 3. Assignations of assignable reversions need not be intimated, but must be recorded in the register of reversions. The recording of the conveyance of a moveable bond, however, does not supply the want of intimation; because the records are not intended to serve for publication, in the case of personal rights, but merely for safe custody, or as a warrant for diligence. 4. A right of lands, not perfected by seisin, does not, from its nature, admit of intimation. 5. Legal, or judicial assignments, such as marriage, or adjudication, need not to be intimated; because they derive force from the law itself, and carry the full right to the subjects conveyed, without the interposition of any legal solemnities. There is nothing

in these conveyances, however, which can put the debtor in *mala fide*; he is, therefore, *in tuto*, to pay to the wife, or to the original creditor in the debt adjudged, until the marriage, or adjudication, be notified to him.

An assignment carries to the assignee all rights which corroborate or strengthen the right conveyed, and all diligences which have proceeded upon it. Hence the assignee may use diligence, either in his own name, or in that of the cedent, while he is alive. But letters-of-diligence, which have been issued in name of the cedent, cannot be executed by the messenger in the name of the assignee; for messengers have no power to judge of the import of transmissions, but are confined, in their executions, to the will of the letters. An assignee, however, may raise a caption in his own name, upon a horning raised in name of the cedent.

In a right conveyed simply in trust, all questions relative to the extent of the trustee's powers depend on the nature and purposes of the trust. If it is intended that the trustee shall have full power over the subject, he may use all acts of property; but if the trust be granted merely for one special purpose, the powers of the trustee, though not limited in the right, ought to go no farther.

After an assignment has been intimated, the debtor cannot prove payment or compensation by the oath of the cedent, unless the matter has been made litigious by an action commenced prior to the intimation. But the debtor may refer to the oath of the assignee, that the assignment was gratuitous, or in trust for the cedent. If the assignment be partly onerous, and partly gratuitous, the oath of the cedent is good against the assignee, only in so far as his right is gratuitous.

All defences competent against the original creditor in a moveable debt, which can be proved otherwise than by his oath, continue relevant, even against an onerous assignee, according to the rule: *Assignatus utitur jure auctoris*.—*Erskine's Institutes*, b. iii. t. v.—*Bell's Dictionary of the Law of Scotland*, v. ASSIGNATION.

ASSIGNMENT. In the law of England, the transferring of the interest which one has in any subject to another person.

Assignments may be made of lands in fee, for life, or for a term of years; of an annuity, rent-charge, judgment, statute, &c. In the case of assignments of lands, they are usually of leases and estates for years. No estate of freehold, or term for years, may be assigned but by a written deed signed by the parties; unless when such assignment takes place by the operation of the law. A possibility, right of entry, title for condition broken, a trust, or *chose in action*, cannot be assigned. A lessee out of possession cannot assign his term, but must first enter, and recontinue his possession, or seal and deliver the deed upon the land, which puts the assignee into ac-

tual possession. If a lessee, for years, assigns the whole of his term, he cannot reserve a rent in the assignment; for he has no interest in the thing, by reason of which the rent reserved should be paid; but debt may lie upon it, as upon a contract. If a lessee, for years, assigns over his term, and dies, his executors shall not be liable for rent due after his decease. Where the executor of a lessee assigns the term, he will not be charged with debt for rent due after the assignment; because there is neither privity of contract, nor estate, between the lessor and executor. But if the lessee himself assigns his lease, the privity of contract remains between him and the lessor, although the privity of estate is gone by the assignment; and, therefore, he shall not be chargeable during his life; but, at his death, the privity of contract also determines.

Although a lessee assigns over his term, he is yet chargeable with debt to the lessor, or his heir, who have not accepted rent from the assignee. But where a lessee assigns his term, and the lessor also his reversion, the privity is determined, and debt does not lie, for the reversioner against the first lessee. In general, the assignee who has the land, and is privy in estate, is debtor in respect of the rent. In the case of an assignment made by an assignee, the first assignee is not liable for the rent; for if he be admitted by the lessor, the admission of one assignee is the admission of twenty. An assignment by an assignee discharges him; and it is not required that he should give notice of his assignment to the lessor.

Where a tenant, for years, assigns his estate, no consideration is necessary; for the tenure being subject to the payment of rent, &c., is sufficient to vest an estate in the assignee. But, in other cases of assignment, some consideration is required to be paid.

The word *heir* is sufficient to make an assignee; and the grantee of a common person is assignee to have benefit of a covenant, grant, &c. The words generally required in deeds of assignment are *grant, assign, and set over*; which may amount to a grant, feoffment, lease, release, confirmation, &c. In these deeds, the granter must covenant to save harmless from former grants, &c.; that he is owner of the lands, and has power to assign; that the assignee shall quietly enjoy, &c. And the assignee may covenant to pay the rent, &c. Some things are, from their nature, not assignable. A bond, being a *chose* in action, cannot be assigned over, so as to enable the assignee to sue in his name. The form of assigning a *chose* in action is of the nature of a declaration of a trust, and an agreement to permit the assignee to make use of the name of his author, in order to recover the possession. The person, however, to whom a *chose* in action is transferred, is rather an attorney than an assignee. But the king had always the right of granting or receiving a *chose* in action by assignment. And in equity,

a *chose* in action is always considered as assignable for a valuable consideration; and the assignee alone becomes entitled to the money. Promissory-notes and bills of exchange, bail-bonds by the sheriff, a judge's certificate for convicting a felon, and the effects of a bankrupt, are made assignable by several statutes.—*Jacob's Law Dictionary*.—*Blackstone's Commentaries*, vol. ii.

ASSIMILATION. The process by which the food of plants, or the elementary substances of which that food consists, are converted into the plants' own substance. See the article **NUTRITION**.

ASTELIA. A stemless plant, of the asphodel tribe. The only species known in Great Britain was brought hither from New Zealand in 1837, and is named *Banksii* in honour of Sir Joseph Banks.

ASTER,—popularly *Starwort*. An extensive genus of plants, of the composite family. The suborder *astereæ* has this genus for its type; and comprises the well-known daisy, the china-aster, the golden-rod, and fifteen other genera. The flower of most of the aster genus, like that of the daisy and the chrysanthemum, closely resembles the popular emblem of a star; and hence both its popular name *starwort*, and its botanic name, which simply means 'a star.' Most of the species rank as ornamental plants; and yet comparatively few are cultivated in flower-gardens. Most of the best known kinds have a rank and coarse appearance in the stem and leaves, and a somewhat staring appearance in the flowers; and yet, except for mere brilliance of tint, several might advantageously compare with some of the pet varieties of the fashionable *cineraria*. The species most commonly cultivated are those designated *amellus*, *alpina*, *hysopifolius*, *punctatus*, *acris*, *canus*, *rigidus*, *linarifolius*, *tenuifolius*, *dumosus*, *ericoides*, and *confolius*. About 160 species, nearly all exotic, exist in Great Britain; and are easily classifiable into seven divisions. The species of the first division are nine in number; they take the ivy-leaved species, *Aster cymbalariae*, for their type; they have variously broad, ovate, oblong, or lanceolate leaves; all are tender evergreen shrubs; nine have usually a height of from 1½ to 3 feet; and six are natives of Van Dieman's Land and New Holland. The species of the small-leaved division, *angustifolii*, are also nine in number; they have narrow or small leaves; all are tender evergreen shrubs; most have a height of from 2 to 4 feet; eight are natives of the Cape of Good Hope; and one, from Carolina, grows 8 feet high, and is very handsome. The species of the few-flowered division, *pauciflori*, are seven in number; and are all hardy deciduous herbs of from 6 to 12 inches in height. The species of the linear-leaved division, *linearifolii*, are about 25 in number; they have narrow, sublinear leaves, and many-flowered stems; all are natives of North America; and, with two exceptions, are hardy perennial deci-

duous herbs, varying in height from 1 foot to 3 feet. The species of the broad-leaved division, *latifolii*, are about 35 in number, exclusive of numerous varieties; they have entire, broad, ovate, oblong, or lanceolate leaves, and many-flowered stems; most are natives of America; all are hardy, perennial, deciduous herbs; several are very handsome; and one, the spurious, is eminently beautiful. The species of the serrate-leaved division, *serratifolii*, are more numerous than even those of the preceding division; they have ovate and lanceolate leaves,—the lower ones serrated; all, with the exception of one biennial, are hardy, perennial, deciduous herbs, varying in height from 1 foot to 8 feet; and one, *Aster tripolium*, growing 2 feet high, and producing blue flowers in August and September, is a native of the sea-shores of Great Britain. The species of the heart-leaved division, *cordifolii*, are nine in number; and, except for having serrated heart-shaped leaves, possess the same general characters as the four preceding divisions.

ASTER (CHINA OR ANNUAL). See CHINA-ASTER.

ASTRAGALUS. A very extensive and important genus of herbaceous plants of the pea tribe. Most of the species are popularly called milk-vetch; and several have a close resemblance to the well-known forage plant saintfoin. See articles MILK-VETCH and SAINTFOIN. An interesting species, known on the European continent under the name of Swedish coffee, but hitherto known in Great Britain almost solely by its botanical name *Astragalus boeticus*, is cultivated to a considerable extent in Germany, and has been recommended for field cultivation in Britain as a substitute for coffee. It is a hardy trailing annual, usually grows to the height of about a foot, produces cream-coloured flowers in June and July, and was introduced to Britain from the south of Europe, as an ornamental plant, in 1759. The mode of culture is precisely the same as for the pea, only the pods are gathered as they ripen. Two-thirds of the seeds are mixed with one-third of coffee beans; and the two ingredients are roasted together, preserved in well-corked bottles or thoroughly closed vases, and taken out as they are wanted to be ground. Adam Ferguson, Esq., of Woodhill, reports, in the Highland Society's Transactions of Feb. 1831, an experimental sowing, with half a pound of seed in drills, on a portion of ground in a thin gravelly soil, in the Highlands of Perthshire. "Circumstances," says he, "unfortunately retarded the period of sowing until the 3d of June, at least two months later than it ought to have been. In addition to this, the rainy and backward season rendered the ripening of the pods almost a total failure. The plants vegetated with great luxuriance; some of the straw, resembling fine tares, measured 3 feet in length, and generally bore 4 pods upon each stalk, and about 6 seeds in each pod. From an anxiety to obtain some of these in a ripe state,

the crop was allowed to stand until the middle of December, when a severe night of frost suddenly blasted every hope. It is certainly, however, sufficiently hardy to ripen in any part of Scotland; and it may be remarked, that in a sharp frost which destroyed the potato stems about the middle of October, the astragalus displayed an important elasticity of constitution; for although it had been severely touched by the frost during the night, it recovered, instead of sinking as the potato does, under the genial rays of the sun." The *Astragalus boeticus* is probably the best substitute for coffee which has yet been tried; and is well worth experimental cultivation in either the garden or the field. *Vicia cracca*, some kinds of lathyrus, and several other hardy leguminous plants, are likewise deserving of attention as substitutes for coffee.—The *Astragalus tragacantha*, popularly called goat's thorn, yields the gum tragacanth of the drug shops, and forms the type of one of several divisions of the astragalus genus. This species is an undershrub, ranks as a medicinal plant throughout the east, and is called by the Persians Kūm, and by the Arabs Kētāl and Kusād. See article TRAGACANTH.—*The Materia Medica of Hindostan*.—*Dr. Christison's Dispensatory*.—*The Quarterly Journal of Agriculture*.

ASTRAGALUS. A bone of the foot; so called because it is shaped like the die used in ancient games.

ASTRANTIA. See MASTERWORT.

ASTRINGENT MEDICINES. Substances which contract and strengthen the animal fibres. They are administered principally in cases of dysentery and diarrhoea, and will be noticed, in their remedial combinations, in our articles on these diseases. Their general effects are manifested by greater firmness of the muscular fibres, greater rigidity of the blood-vessels and diminution of their caliber, and contraction of the exhaling secreting orifices, whereby they check hemorrhage, and diminish exhalation and secretion. In the mouth, they produce a styptic or astringent taste. In moderate doses, they are capable of producing the same constitutional effects as tonics, but they are principally employed for their local effects, to obviate relaxation of the fibres and tissues, and to prevent and check excessive discharges. Astringents may be divided into two sections, the vegetable and mineral. The vegetable astringents owe their peculiar properties to the presence of tannin or tannil, which is found in all of them. They differ only in the proportion of the latter principle, and in the other ingredients with which it is associated. The mineral astringents have nothing in common, but their property of astringency. To the former belong oak bark, galls, kino, catechu, logwood, rhatany, geranium, tormentil, bistort, pomegranate-rind; to the latter, alum, the preparations of lead, zinc, and iron, and sulphuric acid.

ASTROLOBIUM. A genus of ornamental hardy annual plants, of the pea tribe. The species in Britain are four; they are natives of Barbary and the south of Europe; they were formerly included in the *ornithopus* or bird's-foot genus; and they grow about six inches high, have star-like pods, and produce yellow flowers in June and July.

ATHALIA. See TURNIP-FLY.

ATHAMANTA. A genus of herbaceous plants, of the umbelliferous family. One species is popularly called the Cretan carrot, another the Sicilian carrot, and another wild rosemary; but most are known under the name of SPICKNEL: which see.

ATHANASIA. A genus of ornamental, tender, evergreen, shrubby plants, of the composite family. They are of the kind popularly called everlastings, from the durable nature of their flowers; but they suffer some depreciation by sharing that name with the genera *gnaphalium* and *antennaria*. The name *athanasia* is a mere Greek synonyme of everlasting, and literally means deathless. Upwards of fifteen species of *athanasia* have been introduced from the Cape of Good Hope; and ten or twelve more are known to botanists. The name *athanasia* was formerly given to tansy, "either," says Dr. Turton, "because its flowers do not easily wither, or because, if it is stuffed up the nose of a dead corpse, it prevents putrefaction."

ATHEROPO'GON. A genus of grasses, of the tribe subbifloræ. The name signifies 'a bearded awn;' and alludes to one prominent character of the genus. Though upwards of fifteen species are known to botanists, only one, *Atheropogon apudoides*, exists in Great Britain; and this was introduced, about 80 years ago, from the south of Europe. It is a hardy, half-beautiful perennial, grows 2 inches high, and produces its apetalous flowers in August. Some botanists call it *Chloris curtispindula*; and others, *Dinebra curtispindula*.

ATMOSPHERE. The immense mass of elastic fluid which surrounds the globe which we inhabit is called its *atmosphere*, and the mixture of gases of which it consists, *atmospheric air*, or simply *the air*. Nothing perhaps can be more interesting than a knowledge of the nature of this fluid in which we live and move: so intimately connected, indeed, is our whole existence and that of all other living beings with the atmosphere, that those planetary bodies in which no atmosphere has been discovered are generally considered in consequence thereof destitute of organic beings. As our life depends for its existence and continuance on it, so our health and comfort are intimately connected with the changes which it undergoes, and cannot therefore be attended to without knowledge of its physical and chemical nature. If it be furthermore remembered that the atmosphere is the principal agent in combustion, and that, until the discovery of the steam-engine, it constituted an important mechanical power on which, until lately, navigation

has from time immemorial been dependent, and that possibly the time is not far distant when it may become the principal medium for locomotion, its importance in the condition and development of mankind will easily be conceived.

Chemical nature of the atmosphere.—Common atmospheric air was for a long time considered as a simple element. The first knowledge of the composition of the atmosphere must have been after the period of the discovery of oxygen gas by Dr. Priestley in 1774. Lavoisier, indeed, in his posthumous works, appears to insinuate a knowledge of it in 1772. But this claim cannot be admitted, as he gives no hint of any such knowledge in his volume of essays published after that period, and as he was entirely unacquainted with oxygen gas when Priestley showed him the way to prepare it at Paris, about the end of 1774. It is very probable that Lavoisier became acquainted with the composition of atmospherical air not very long after that period; though some years elapsed before he made it known to the public. Whether he preceded Scheele in his knowledge of this important fact, we do not exactly know. But there is no doubt whatever that Scheele's investigations were carried on without any assistance from abroad, and that it was in consequence of the publication of his 'Treatise on Air and Fire,' that the chemical world became acquainted with the nature and composition of atmospherical air. This important work was printed at Upsal in 1777, with an introduction by Bergmann, and translated into English by Dr. Foster in 1780. The experiments of Priestley indeed would have warranted the conclusions respecting the composition of atmospherical air drawn by Scheele; but those of Dr. Priestley were different and more complicated. In Scheele's first experiments, he estimated the bulk of oxygen gas in air at 30 per cent. But in the year 1779, he published a set of experiments continued for a whole year, in order to ascertain whether the bulk of oxygen in air be constant, or varies with the season of the year. He found it in general remarkably constant, and amounting to 27 per cent. The smallest bulk was 24, and the greatest observed was 30 per cent. Dr. Priestley had made similar experiments, and had estimated the bulk of the oxygen at $\frac{1}{3}$ th of the air, or 20 per cent. Mr. Lavoisier's experiments, which were very numerous and varied, almost coincided with those of Scheele. He considered air as composed of 27 parts by bulk of oxygen, and 73 of azote. Mr. Cavendish's experiments were published in the Philosophical Transactions for 1783. He proved decisively that the proportion of the azote and oxygen in the atmosphere does not vary; and by a very careful analysis, concluded, that 100 parts of air in bulk are composed of

79·16 azote
20·84 oxygen

100·00

This opinion was not at first acceded to by chemists, misled by the previous conclusions of Scheele and Lavoisier; and it was not till towards the commencement of the 19th century, that the true proportion of these constituents was generally known. The experiments of Berthollet in Egypt and in Paris, seem to have led the way to it. These were almost immediately confirmed by those of Davy, Beddoes, and many other chemists. Atmospheric air was thus proved to consist of at least two gases of different and almost opposite natures.

Besides these two gases, oxygen and nitrogen, which form its main ingredients, the atmosphere contains also a small portion of carbonic acid, and variable quantities of vapour of water. The two latter, although in less quantity, form a no less important part in the economy of animals and plants than the oxygen; while the nitrogen, as far as yet ascertained, seems mostly to serve for the purpose of a neutral diluent for the other ingredients.

The following may be considered as the average constitution of the atmosphere :—

	By volume.	By weight.
Oxygen	20.50	22.76
Nitrogen	78.16	76.15
Vapour of water	1.25	1.03
Carbonic acid	0.04	0.06
	<hr/> 100.00	<hr/> 100.00

To the above constant ingredients of the air may also be connected several accidental substances, dissolved or diffused through it from local or special causes, becoming in some instances the source of great distress or annoyance to man.

Oxygen.—It has been found by carefully conducted experiments that the proportion of oxygen in 100 volumes of dry air is not subject to variation, but remains constant, amounting to between 20.8 and 21 volumes. This result has been obtained with air taken in cities as well as in the country, from under the equator or from the arctic regions, from the tops of high mountains or in valleys, from great elevations in the air or from the level of the sea, in day-time or during the night. Even in marshes, or when taken from crowded rooms, theatres, &c., it exhibited no perceptible deficiency of oxygen. The proportion of oxygen and nitrogen may therefore be considered as constant, or at least not to vary more than between one and two-tenths of one per cent., which may be considered within the limits of experimental accuracy. Generally, omitting carbonic acid and water, it is considered as containing 21 volumes of oxygen and 79 volumes of nitrogen, or by weight 23.1 oxygen and 76.9 nitrogen. The last results of Dumas and Boussingault yielded oxygen 20.81, nitrogen 79.19, or by weight, oxygen 23.01, nitrogen 76.99, with a variation in the results of 0.17 per cent. It may, however, be remarked that, according to some very lately published results by Lewy of

analyses of air from the North sea and from the isle of Guadeloupe, he has arrived at the conclusion that the quantity of oxygen in the atmosphere varies, and that this variation, although within so small limits on the continent as to render its estimation somewhat uncertain, is nevertheless much greater over the sea, amounting to 0.46 per cent. His analyses were performed by the same method as employed by Dumas and Boussingault. See farther below.

If the air were of uniform density, its height, as inferred from the barometer, would be about 5.238 miles. Making an allowance for the contained vapour of water and carbonic acid, and assuming its height to be 4.6 miles and the radius of the earth to be 3,956 miles, the volume of the atmosphere would be 906 millions of cubic miles, of which the oxygen would form 19,025,000 cubic miles.

The quantity of oxygen consumed by a grown person in 24 hours is, according to Lavoisier and Davy, about 45,000 Par. cubic inches, or 26.04 cubic feet. From this it has been calculated that the yearly consumption of oxygen by all mankind, assumed at 1,000 millions of people, would only amount to about 77.6 cubic miles, and that therefore the present amount, if it could be consumed to the last portion, would suffice for 2,451,000 years, and if the same number of people had existed since the time of the creation, only $\frac{1}{45}$ of the present volume of oxygen would have been consumed, a diminution entirely too small to be ascertained at present by experiment. One-tenth of a per cent. of the air contains oxygen enough for the supply of the whole present population for 10,000 years.

If thus on the one hand it must be admitted that the quantity of oxygen consumed by mankind, even for a considerable length of time, could not diminish it sensibly; it must on the other hand be remembered, that much larger quantities are annually consumed by the whole animal kingdom, and by combustion and other oxidizing processes, and that a sensible diminution of the oxygen might at last occur, if this consumption were not in some other way counteracted. This is done by plants, which inhale carbonic acid and liberate oxygen. How far they in this point counterbalance the consumption, we have as yet no means of determining with accuracy. It will, however, afterwards be seen that even this is probably not the case.

The constancy of the proportion of oxygen in the composition of the air must be explained by the great mobility of its particles and the diffusive power of its constituents, by which any difference is rapidly equalized. The same must be supposed to take place in crowded places or rooms where the windows and doors are never so close as not to allow a considerable exchange of air to take place through them. For in hermetically closed rooms oxygen is known to disappear by respiration, and to be replaced by nearly an equal

volume of carbonic acid. The oppression and other injurious effects of such air must therefore be ascribed more to the temperature and to the presence of other noxious substances, as carbonic acid and exhaled animal substances, than to a want of oxygen.

It has already been stated that, in abstracting the oxygen from the atmosphere by any substance which will combine with it, the remaining gas consists almost entirely of nitrogen, but mixed with a minute quantity of carbonic acid and watery vapour.

Nitrogen.—The principal characteristic of nitrogen is its indifference to oxygen, as well as to other substances, and its consequent apparent reluctance to enter directly into combination with them. Its use seems, therefore, principally to be to dilute the oxygen; for, from the powerful affinity of this latter substance, it is obvious, that if it alone constituted our air, it would soon, with the present arrangement of our earth and its inhabitants, produce universal destruction, for all animals would perish from the excessive influence of the oxygen on the blood and the respiratory organs, and the greatest part of all combustible matters would soon be involved in one general conflagration. It may, however, be remarked that, although the nitrogen of the air does not seem necessary by itself to the continuance of life, nor any direct reaction between it and the living creation has yet been found to exist, yet it forms an invariable and essential constituent of both animals and plants.

From the fact of the invariable proportion of the oxygen to the nitrogen, and this ratio being very nearly as 1 to 4, some chemists have advanced the idea that the air is a chemical compound of 1 volume of oxygen with 4 volumes of nitrogen, forming a compound with half as much oxygen as in nitrous oxide; but, if this were the case, it would afford the only instance of a mechanical mixture having exactly the same properties as a chemical compound. For an artificial mixture of oxygen and nitrogen in the same proportion does not differ in any respect from the air, and yet that they enter into no chemical combination by their mixture is evident from the absence of any change in temperature or volume. Besides the fact that nitric oxide abstracts oxygen from the air, being thereby converted into hyponitrous acid, would thus afford an instance of one oxide reducing another of the same radical and liberating the latter, which would be both improbable and without a parallel. The objection that the oxygen, as the heavier gas, ought in still weather to settle down at the bottom in the lower strata is unfounded, since gases mix together as liquids of different specific gravity, without any tendency to subsequent separation by mere gravitation. On the contrary, the law of diffusion of gases would make them mix and penetrate each other perfectly without any mechanical agitation.

Carbonic acid.—The existence of carbonic acid in the air may be easily proved by exposing lime or barytic water in an open vessel to the air, or passing the latter through their solution, when a precipitate will be formed, which effervesces by the addition of an acid, and consists of carbonate of lime or baryta. Like the two former cases, the carbonic acid is diffused through the whole atmosphere; its proportion is, however, very small. By a series of experiments, carefully performed by Th. de Saussure, it has been ascertained that the mean proportion of carbonic acid in the air does not amount to more than 0.0004, or 4 volumes in 10,000 volumes of air, but that this amount varies from 0.00057 as a maximum to 0.00032 as a minimum. During the night its proportion is greater than during the day, and in populous cities greater than in the country, and also in winter and in high situations greater than in summer, or in low situations, owing probably to the effect of vegetation. Dry weather and frost seem also to increase its amount, probably by preventing absorption by the soil, while over lakes and other waters, and after rain, it is somewhat less.

Notwithstanding the small proportion which the carbonic acid bears to the whole atmosphere, its presence is of the highest importance in an economical point of view. We have seen that the animal kingdom consumes annually an immense quantity of oxygen which it converts into carbonic acid, while, on the other hand, the plants again absorb the carbonic acid and return the liberated oxygen to the air; for, although during the night they absorb oxygen and exhale carbonic acid, the reversed action during the day predominates greatly. The very existence and continual growth of plants seem, therefore, to depend on the presence of the carbonic acid. How far animals and plants counterbalance each other we have not yet been able to ascertain by direct experiments, but considering the continual increase of carbonaceous matter in the soil, and the immense deposits of carbon as coal and lignite, which owe their origin to a previous vegetation, it would seem, indeed, that the amount of carbonic acid in the atmosphere must have been formerly greater, and that its absorption by plants so far prevails over the causes which reproduce it as to cause its slow but steady diminution.

Carbonic acid acts as a poison to man when inhaled. Its accumulation, by respiration, and the burning of lights in crowded and lighted rooms, constitutes, therefore, a frequent cause of the vitiation of the air in such places, and its injurious effects are even felt before it reaches the amount of one per cent.

Vapour of Water.—A continual evaporation taking place from seas, lakes, rivers, and other waters, as well as from the soil in general, these vapours diffuse themselves through the air, and form an important constituent of it. Vapour of water not being a permanent gas, as the other

constituents of the air, but condensible again to water by cold; their presence can easily be proved by reducing artificially its temperature. Thus, if a pitcher be filled with ice; the vapours of the air will be seen to condense on its outer surface, as a dew, and collect into drops of water. It has been asserted that, by the above evaporation, the water dissolves in the air as a salt in a liquid. But it has been found that evaporation takes place equally well in vacuo, and that here at equal temperatures the same amount of vapour will form in a given space as if it were filled with air. If, therefore, no other atmosphere existed, the earth would still be surrounded by an atmosphere of watery vapour; the quantity of it, therefore, only depends on the temperature. The atmosphere, therefore, so far from facilitating the evaporation of water, is rather an obstacle to its diffusion, since, in a vacuum, it would expand itself with the utmost velocity. That wind and other commotions of the air facilitate the evaporation, depends upon the removal of the vapour formed from the surface of the water, whereby further evaporation would be prevented.

The amount of vapour varies according to the temperature of the atmosphere and other circumstances, from $\frac{1}{2}$ per cent. to more than 4 per cent. by vol. Verner found as a mean of 50 experiments, in 1,000 parts of air, 8.47 parts of vapour, the maximum being 10.18, the minimum 6.1. In the forenoon, and before 2 o'clock, the mean was 7.97, after 2 o'clock till evening, 8.85. In general, the higher the temperature, the greater is the absolute quantity of vapour. In the same way it is greater in summer than in winter, in day-time than in the night, in warm and low countries than in cold and mountainous, and in the proximity of seas and rivers, greater than farther inland. Much depends also on local circumstances, as the peculiar property of the soil, the facility of drainage, the prevalence of certain winds. The atmosphere, however, rarely contains at any temperature the full amount of vapour which it is capable of taking up. If this be the case, all further evaporation from the surface of the earth into it must of course cease; while, on the other hand, if its content of vapour be considerably below its capacity for it, evaporation is much more rapid, and the air is then said to be dry. Hence the different influence between dry and damp air on the animal body, which must continually throw off a certain amount of moisture by evaporation from the skin, in order to keep it of a certain moisture and temperature, which is necessary to the preservation of health.

If we compare the *absolute* quantity of vapour with the quantity which the atmosphere at the same temperature is capable of taking up, we obtain the *relative* quantity of the vapour or the degree of moisture. It will thus be seen, that with the same absolute quantity of vapour, the moisture of the air depends on the temperature, and that at a higher temperature, the air may

still be drier than at a lower temperature, although the absolute quantity of vapour be larger in the former than in the latter case, and that air which at a certain temperature feels damp and uncomfortable, by a slight increase in the temperature may become comfortable. In summer, and in warmer climates, the absolute quantity of vapour is generally larger, but the relative quantity smaller. The relative quantity of moisture in the atmosphere, may be determined by ascertaining how far the air may be cooled down before it deposits any moisture on a cooled body, which temperature is called its dewpoint. See *HYGROMETRY*.—When the atmosphere becomes perfectly saturated with vapour, the slightest cooling will cause the vapour to condense and assume the liquid form. When this takes place, the condensed vapour separates first as fine vesicles floating about in the air of from $\frac{1}{800}$ to $\frac{1}{400}$ inch in diameter, thus constituting the common phenomena of clouds and fogs, which by collecting into drops or freezing, form rain or snow.

Clouds.—So long as aqueous matter remains in the state of vapour, it is transparent. On its first condensation a cloud appears. The manner of the formation of clouds is as follows:—Water on its first condensation tends to unite in the form of hollow globules, or vesicles containing air; as it parts at the same time with its latent heat, the air, as well within the vesicles as between them, is rarefied, and the united mass of water and rarefied air may remain as light as an equal bulk of atmospheric air, or even lighter. Clouds may, therefore, remain floating in the atmosphere, or even rise. As this heat is dissipated, the clouds grow heavier and fall, while the air in the vesicles losing its elasticity, permits them to be broken by the internal pressure. The water then runs into drops, which, being many times heavier than atmospheric air, descend, forming rain.

Clouds may be formed in all cases where the temperature of the ground is lower than that at which the vapour, mixed with atmospheric air, can remain permanent. Thus, whenever a warm wind flows over a cold surface, mists and fogs take place; and if the difference of temperature be considerable, they may break into rain. For an equal difference of temperature between the ground and air, it may be shown that the greatest quantity of precipitation will take place, when the two unequal temperatures are both high. Thus the causes that would produce heavy rains in warm climates, may produce no more than fogs, or dense mists, in those that are colder. Clouds may also be formed on sudden changes of wind, when two masses of air are mixed that are both nearly saturated with moisture. It is to this cause that nearly all the rains of temperate climates are due. The passing of warm winds over cold surfaces, rarely produces more than mists or fogs, except in warm climates. When clouds, after being formed, begin to descend, in

consequence of the dissipation of the heat, by the rarefaction arising from which they are supported, they often reach strata of the atmosphere comparatively dry, and of higher temperature than they themselves possess. In such a case, the vapour may be again taken up, and the cloud dissipated. Thus clouds are frequently seen to roll down the sides of the mountains, and to disappear at a certain level; this is a proof of a dry state of the air beneath, and is therefore considered by the inhabitants of mountainous countries, as a prognostic of fair weather. When a cloud, on the other hand, formed in high and cold regions, passes in its descent through strata saturated with moisture, or nearly so, it may cool them until precipitation ensue; the precipitated moisture, uniting itself to the descending cloud, will augment the intensity of the rain it causes. Thus the same rain will be more copious in valleys, than upon the neighbouring mountains; and the difference is so sensible in this respect, that it has been detected by means of the rain-gauges at the observatory of Paris, one of which is upon the ground, the other upon the terraced roof of the building.

Snow.—When the precipitation of vapour ensues at temperatures below the freezing point, *snow* is formed; the particles of the condensed aqueous matter being free to move in any direction, arrange themselves under the action of their mutual attraction, in the manner of crystals. These crystals have usually the figure of six-pointed stars; and the aggregation of broken crystals of this shape forms flakes of snow.

Hail.—*Hail* is a phenomenon that is not completely explained; the best theory on the subject, although not absolutely satisfactory, is as follows:—It is known that when water is frozen in a torricellian vacuum, it granulates and assumes the form of hail; hail also reaches the ground with a very great velocity: hence we may conclude, that it is formed in very rare air, and in a high region of the atmosphere. The decomposition of organic substances, is constantly giving out hydrogen gas, and this, from its specific levity, rises to the higher regions of the atmosphere; hence, as no gas can remain long over another unmixed, it mingles with atmospheric air, and becomes susceptible of being inflamed by electricity. Should it be thus acted upon, it forms water, will be condensed into a space much less than it formerly occupied, and would leave a vacuum, did not the adjacent portions of air rush in to fill the void. The sudden rarefaction of this air will produce an intense cold; the newly formed water will be frozen, and under circumstances that will cause it to granulate; descending from a lofty region, it will have great velocity; formed from hydrogen gas, and by the electric discharge, it will occur most frequently during the summer months, and accompany lightning.

Dew.—The earth retains a constant mean temperature, under the joint action of solar and ter-

restrial radiation; but the rate of these is unequal, not only at different seasons, but from hour to hour; the former ceases altogether at the setting of the sun, while the latter continues for a time undiminished. Hence the surface of the earth cools rapidly after sunset, and may speedily reach the dew-point of the air in contact with it. So soon as this is the case, moisture begins to be precipitated, and a cloud is formed, the descent of the water of which this is composed, forms the deposit, that we call *dew*. The cooling will be propagated slowly upwards, and the cloud will appear to rise; notwithstanding which, the moisture of which it is composed, actually falls. After some hours, the earth and air will assume the same temperature, and the cloud will disappear. The first morning rays of the sun, passing horizontally through the air, will heat it, long before their influence can be felt upon the ground. The air will therefore acquire a greater capacity for moisture; if there be any water in the vicinity, vapour will rise, and propagate itself through the mass; but as the ground still remains colder, a new precipitation will ensue; thus dew will again be formed, and moisture occur in the morning.

When the surface of the ground, or of any other substance, is cooled by radiation to the temperature of 32° , the dew is frozen, and takes the form of white or *hoar frost*; this may often be deposited, when the temperature both of the air and of the ground at a very small depth, is above that of freezing.

When clouds exist in the atmosphere, the radiation is impeded, and dew will not be formed. Thus a want of dew is usually a prognostic of rain. When the air is still, dew is most copious, and thus it falls in greatest abundance in sheltered situations, and frosts will continue later in the spring, and begin earlier in autumn, in valleys than on the open hills in the vicinity. The motion of air mixes the portion cooled by contact with the earth, with that which is not, and brings new masses into contact; hence, although the loss of heat by radiation, may be as great or even greater, the ground will receive heat from the air, and the change of temperature will be less. In conformity, heavy dews do not fall during the prevalence of high winds, and hoar frosts rarely occur while they blow. Surfaces that radiate well, will be most cooled, and will in consequence receive the greatest quantity of dew; and thus of land frequently tilled, and that which is left undisturbed, the latter will derive most moisture from the atmosphere in this form.

The moisture of the air plays an important part in the economy of the earth. To it is due the constant irrigation of its surface, keeping up a constant circulation by evaporating from the sea and other great reservoirs, being carried inland by the wind and other commotions of the air, and there again condensing on mountains and other high and colder places, collecting into springs, creeks, &c., or depositing itself more

diffusedly as dew, or precipitating itself more vigorously as rain, &c., and thus again returning to its first origin. Without the presence of the moisture in the atmosphere, neither plants nor animals could live. To it is also due the constant decomposition and decay of animal and vegetable substances; and even the rocks and mountains wear away and decay under its all-levelling influence, for besides its own dissolving power, it seems to be that which lends to the other destroying agencies of the atmosphere their force and efficacy, for without it they seem inert, at least at ordinary temperatures. In dry air, steel does not rust, nor does wood decay.

Other ingredients in the Atmosphere.—Besides the above-named constant ingredients of the atmosphere, a number of other gases and vapours are known to enter it in certain localities, but they are too inconsiderable in quantity to be detected afterwards in its general composition. As such may be mentioned sulphuretted hydrogen, chlorohydric acid gas, carburetted hydrogen, &c. Boussingault has proved the constant presence of a minute trace of a carburetted hydrogen, or some other similar compound, by passing atmospheric air over ignited oxide of copper, whereby he obtained carbonic acid gas and water, from which he had carefully freed it previously. The air had also previously passed through concentrated sulphuric acid, so that they could not derive from dust or other mechanically suspended organic particles. The final products of the decay of animal and vegetable matters being carbonic acid, water, and ammonia, which escape into the atmosphere, Liebig infers that the latter gas ought never to be absent, although in too minute quantity to be detected directly by ordinary experiment, but according to him, it always exists in rain water. Rain is also the principal mean of carrying down again most other accidental substances, either dissolved or suspended in the atmosphere, among which may be included the different miasmata and matter of contagion, which are perceptible only by the senses or by their effect upon the human system, but cannot otherwise be detected by chemical tests, although we may destroy them, or at least their injurious effects, by chemical means, such as by muriatic, nitric, or acetic acids, or chlorine gas. The action of the atmosphere itself tends necessarily to destroy or oxidize them by the combined influence of oxygen with light and heat.

Physical properties of the Atmosphere.—We have thus seen that the atmosphere consists of a mechanical mixture of three permanent gases, and one condensable. Its physical and mechanical properties are therefore such as might be calculated from a mixture of them. 100 cubic inches of atmospheric air, deprived of its carbonic acid and aqueous vapour, weighs, according to Dr. Prout, 31·0117 grains, at 60° temperature, and 30 inches barometric pressure, and its specific gravity at this temperature is generally taken as

the standard for comparison with other gases, and therefore set equal to 1 or 1,000. Compared with water at 62° it is 815 times lighter than water, and 11,065 times lighter than mercury. At 32° Fahrenheit, it is 770 times lighter than water or its specific gravity = 0·001299 that of water at 39° = 1. The weight of the atmosphere pressing upon the surface of the earth, is equivalent to about fifteen pounds on each square inch of surface, or equal to the weight of a column of mercury of 30 inches, or a column of water of nearly 34 feet in height. But this pressure varies continually from the different changes in its variable constituents, from its commotion by currents of air, and from other causes. These differences are indicated by the rise or fall of the mercurial column in the barometer (see this). Its mean pressure being taken at thirty inches of mercury, the contribution to this pressure of its different constituents, which may be considered as independent atmospheres, will be as follows, the amount of vapour being calculated from the capacity of the air at 50°.

Pressure of the Oxygen,	8·828 inches.
“ Nitrogen,	22·845 „
“ Watery vapour,	0·309 „
“ Carbonic acid,	0·018 „
	<hr/> 30·000

The weight and pressure of the atmosphere may be ascertained by very simple experiments. If we immerse in water a glass tube open at both ends, the water included in the tube will be on the same level with the fluid which surrounds it. When we apply our mouth to the upper end of the tube, and draw out the air, the included water instantly ascends till the weight of the elevated column added to the elasticity of the remaining air, exactly balances the pressure of the atmosphere on the surrounding fluid. If we now take a long tube, forty feet long for example, shut at one end, and having filled it with water, plunge the open end into a vessel of water, the fluid will then descend in the tube till the weight of the column exactly equals the pressure of the atmosphere; for the air is now excluded from the upper part of the tube, and the weight of the column of fluid is the only force which is left to balance the weight of the atmospherical column. By making this experiment, it will be found that the water stands at from 34 to 35 feet above the general level of the surrounding fluid, and therefore the weight of a column of air reaching to the top of the atmosphere, is equal to the weight of a column of water, of the same base, with the altitude of 34 feet, or about 21,564½ pounds on a square foot, or 15 pounds on every square inch. This experiment may be more easily made by using quicksilver instead of water. The quicksilver will rise to the height of 29 inches in the tube, and will thus measure the pressure of the atmosphere. Hence it follows, that the whole atmosphere exerts the same pressure on the surface of the earth, as if the surface of the

globe were covered with water to the depth of 34 feet, or with quicksilver to the depth of 29 inches. This pressure has been computed at 12,022,560,000,000,000 pounds, or as equivalent to that of a globe of lead 60 miles in diameter; and if we suppose that a man's body exposes a surface of nearly 15 square feet, he will sustain a pressure of 32,343 $\frac{1}{2}$ pounds, or 14 $\frac{1}{2}$ tons.

As the different strata of the air are subjected to the pressure only of the superincumbent strata, it follows, that the pressure must decrease from below upward, and as the elasticity of the air will cause it to expand, as the pressure is removed, its density will also decrease; but as we ascend in a regular arithmetic progression, the density of the air decreases in a geometrical progression. The decrease in density is therefore much more rapid than the increase in height. So that for every 2·705 miles (11,556 feet), the density is about halved, as shown by the following table:—

Height above the sea in miles.	Density.
0.	1
2·705	$\frac{1}{2}$
5·41	$\frac{1}{4}$
8·115	$\frac{1}{8}$
10·82	$\frac{1}{16}$
13·525	$\frac{1}{32}$
16·23	$\frac{1}{64}$

It might be supposed from this, that the atmosphere would extend itself infinitely into space; but that it does not extend to several of the other planets, can be proved by astronomical observations. It certainly has a limit, either from a limit in the elasticity or expansibility of gases, or from the counteraction of these properties by the cold prevailing in the higher regions. From calculations founded on the phenomena of refraction, the sensible atmosphere would seem not to extend beyond 45 miles.

When a ray of light enters the atmosphere, it is bent from its course by the same cause which refracts the rays of light when they pass through any dense medium, such as glass or water. The refraction sustained by light at its first entrance into the atmosphere must be very small, from the extreme rarity of the air. The deviation, however, will gradually increase as it penetrates the denser strata, and the ray will describe a path increasing in curvature as it approaches the earth. From this property of the atmosphere, the apparent altitude of the sun, moon, and stars, is greater than their real elevation, and they appear to be raised above the horizon when they are actually below it. The refraction of the atmosphere near the earth's surface is liable to very considerable anomalies. But while the solar rays traverse the earth's atmosphere, they suffer another change from the resisting medium which they encounter. When the sun, or any of the heavenly bodies, are considerably elevated above the horizon, their light is transmitted to the earth without any perceptible change; but when these bodies are near the horizon, their light

must pass through a long tract of air, and is considerably modified before it reaches the eye of the observer. The momentum of the red, or greatest refrangible rays, being greater than the momentum of the violet, or least refrangible rays, the former will force their way through the resisting medium, while the latter will be either reflected or absorbed. A white beam of light, therefore, will be deprived of a portion of its blue rays by its horizontal passage through the atmosphere, and the resulting colour will be either orange or red, according to the quantity of the least refrangible rays that have been stopped in their course. Hence the rich and brilliant hue with which nature is gilded by the setting sun; hence the glowing red which tinges the morning and evening clouds; and hence the sober purple of twilight which they assume when their ruddy glare is tempered by the reflected azure of the sky. We have already seen, that the red rays penetrate through the atmosphere, while the blue rays, less able to surmount the resistance which they meet, are reflected or absorbed in their passage. It is to this cause that we must ascribe the colour of the sky, and the bright azure which tinges the mountains of the distant landscape. As we ascend in the atmosphere, the deepness of the blue tinge gradually dies away; and to the aeronaut who has soared above the denser strata, or to the traveller who has ascended the Alps or the Andes, the sky appears of a deep black, while the blue rays find a ready passage through the attenuated strata of the atmosphere. It is owing to the same cause that the diver, at the bottom of the sea, is surrounded with the red light which has pierced through the superincumbent fluid, and that the blue rays are reflected from the surface of the ocean. Were it not for the reflecting power of the air, and of the clouds which float in the lower regions of the atmosphere, we should be involved in total darkness by the setting of the sun, and by every cloud that passes over his disc. It is to the multiplied reflections which the light of the sun suffers in the atmosphere, that we are indebted for the light of day, when the earth is enveloped with impenetrable clouds. From the same cause arises the sober hue of the morning and evening twilight, which increases as we recede from the equator, till it blesses with perpetual day the inhabitants of the polar regions. The absolute refractive power of the atmosphere is 0·0005891712, and its relative power considered as unity. Its specific heat is also assumed as unity for comparison with other gases. Compared with that of water it is = 0·2669. By rarefaction its capacity for heat is increased, but not in a direct ratio.

Like other gases, atmospheric air expands 0·002028, or $\frac{1}{493}$ of its bulk at 32°, for each degree of Fahrenheit. If, therefore, the air at any given place become heated, it expands, whereby it becomes lighter than the rest, and ascends, being replaced by colder and heavier air flowing

into its place from the sides, which again, in its turn, becoming heated, ascends in the same manner, and thus constitutes an ascending current or upward draft from the place where it is heated. Were it not for this no fire could continue for any length of time, since it must necessarily be extinguished as soon as the surrounding oxygen were absorbed, but the air being heated, at the same time it becomes lighter, and ascends, and thus causes an afflux of fresh air from the sides or from below, by which the combustion is maintained. The different commotions of the air, such as wind, gales, and hurricanes, owe their origin also to the same cause, the primary movement being always an ascending current, produced by the heated and expanded air, over some spot rising in a vertical column, and the denser and colder air rushing towards this point, and thus producing the above horizontal currents on the surface of the earth. The following table exhibits the rate of expansion of air from 32° to 212° , according to Mr. Dalton:—

Degrees of Fahrenheit.	Bulk of Air.	Degrees of Dalton's Thermometer.
32°	1000	32
39·3	1017·9	42
47	1036·1	52
55	1054·7	62
63·3	1073·5	72
72	1092·7	82
81	1112·3	92
90·4	1132·2	102
100·1	1152·4	112
110	1173·1	122
120·1	1194	132
130·4	1215·4	142
141·1	1237·1	152
152	1259·2	162
163·2	1281·8	172
175	1304·7	182
186·9	1328	192
199·2	1351·8	202
212	1376	212
359·1	1643	312
539·8	1962	412
754·7	2342	512
1000	2797	612
1285	3339	712

The reader will observe, that the expansion of air in the second column of the table constitutes a geometrical progression, the ratio of which is 1·0179. The third column exhibits the corresponding degrees of a Fahrenheit's thermometer graduated, according to Mr. Dalton's notion of the expansion of mercury, according to the square of the temperature.

The temperature of the atmosphere is greatest near the earth, because the air transmits the rays of light without decomposing them, and cannot, therefore, be heated by them before they reach the surface of the earth, where they are decomposed and their heat set free. The air, which thereby becomes warmed, ascends and mixes with the upper colder strata. This is the reason why the atmosphere becomes colder as we ascend into it, until, even in the hottest summer season, its temperature sinks below the freezing point. In the lower strata this decrease of temperature has

been found to amount to about 1 degree for every 352 feet of ascent, although at greater elevations the decrease is probably less rapid. This is also the reason why the temperature decreases in ascending high mountains until, even in the warmest climates, the region of perpetual congelation may be attained. Thus the summits of the Andes under the equator are covered with perpetual snow and ice. The height at which this line of perpetual congelation is attained has been fixed at 15,207 feet under the equator, but decreases progressively in higher latitudes, being 3,818 feet at 60° latitude, and only 1,016 at 75° latitude.

Climate.—The comparative warmth of any locality greatly, though by no means wholly, depends on the quantity of sunbeams which it receives. In consequence of the sphericity of the world, only the portions of it close to the equator receive the cylinders of the sun's rays upon a level base, and all other portions, in the degree in which they lie distant from the equator, receive these upon an increasingly oblique base; so that a district or patch of ground of any given extent near the equator basks under a far denser play of sunbeams than a district or patch of equal extent situated at a distance from the equator. For the same reason, though on quite a mimic scale, when the southern and the northern sides of a hill are simultaneously under sunshine, the southern side enjoys a far denser play of rays, and is therefore far more acted on by both light and heat, than the northern side. A southern exposure in a farm is thus a mighty element in local climate; and, provided the declivity be considerable, and the conditions of soil, drainage, and ventilation be equal, it may amount, in practical value, to a superiority of several degrees southward over a neighbouring farm of northerly exposure.

Yet the character of the upper strata of the terrestrial surface, the dryness, siliceousness, and porosity of the soil, the state of cultivation, the absence of morasses, and particularly the altitude above sea-level, and the character of the neighbouring countries and seas, exert, both individually and combinedly, a strongly modifying influence upon the atmosphere, and impart a distinctive character or important peculiarities to local climate. When much damp ascends into the air from prevailing marshiness of surface, it rarefies the atmosphere, decreases its calorific capacity, and, in consequence, renders the local climate cold, chilly, and replete with ungenial vapour. But by a beautiful law of the almighty and all-benevolent Governor of the universe, the physical constitution of the atmosphere combines with the operations of husbandry to reduce and eventually to destroy such local causes of noxiousness. That not much cold air and damp air shall accumulate in any one place, is provided for by a decrease in the atmosphere's capacity for watery vapour proportionately to the fall of its temperature; and that chilliness and dampness shall be

driven from the climate of a district by thorough cultivation, is provided for by the disappearance of the stagnant waters and the bibulous and spongy surfaces whence the local atmosphere was formerly charged with vapour. When all the land of a district has been thoroughly drained, and all its ascending and accumulating waters either drawn off to a river-course, or gathered into such small deep pools as present comparatively trivial scope for evaporation, the local atmosphere receives less vapour, acquires increase of capacity for direct solar heat, and obtains a larger amount of radiated heat from the ground; so that, though the same quantity of rain fall annually as before, the stratum of air immediately over the soil, or the actual climate of the district, will possess a far higher degree of both dryness and heat. Hence, the foulness of our pastures, the poverty and lateness of our crops, the stiffness of our carses, the miriness of our loams, the wetness of our vegetable moulds, the spoutiness and rankness of our meadows, the blights upon our crops, the occasional pestilences upon our flocks, and the frequent coughs and fevers and consumptions of our families, ought, in multitudes of instances, to be ascribed, not to the raininess of our climate, the fickleness of our seasons, or the chilly dampness of our atmosphere, but either mainly or solely to the bad agricultural condition of the soil. Let the ground be effectually drained, and the heart of the air upon the farm will be immediately and permanently warmed; and rain, while sent in due quantity to refresh the fields, will no longer lie upon their surface or stagnate within their bosom, to poison the suffused atmosphere with fogs and miasmata. An increase of atmospheric heat without a corresponding drainage of terrestrial surface, would not only be useless but most malign. The coughs, asthmas, consumptions, and intermittent fevers which arise from the cold, damp air of a churlish and niggard country, are mild in their character and gentle in their operation compared to the fierce fevers, the murderous diarrhoeas, and the fell and furious inflammations which scourge the population of a warm damp air in regions of moist, rank, luxuriant vegetation. The agues of our own fenny districts are playthings in comparison to the red-hot pests and plagues which desolate the low wet regions of the Levant and the tropics. About a century ago, a wind which sweeps across the vast swamps and oozy mangrove thickets of the sultry plains of Benin, and rushes down with their loads of putrid vegetable exhalations upon the coast of Guinea, made such wholesale havoc upon the towns of negro-land, that the surviving were not numerous enough to bury the dead. But the considerations of climate are so pumerous, so intricate, and of such mighty connexion with agriculture, that they must form the topic of a separate article. See the article CLIMATE.

Economical Relations of the Atmosphere.—The

agencies of the atmosphere act in intimate connexion with all organic functions and very many mineral changes in our world; and therefore affect the interests and occupations of the cultivators of the soil at a thousandfold too many points, or in a thousandfold too many ways, to be mentioned or even hinted at in a brief general notice. Some of the chief are more or less fully discussed in our articles AGRICULTURAL CHEMISTRY, VEGETABLE PHYSIOLOGY, AIR, OXYGEN, CARBONIC ACID, AMMONIA, AZOTE, HEAT, CLIMATE, RAIN, SNOW, and AERATION; and others form the topic of a considerable portion of many of our other articles. We shall here do no more than state a few practical inferences, bearing upon the health, comfort, and professional success of gardeners and farmers.

The sites of dwelling-houses and of farmeries ought to be selected in places remote from ponds, marshes, and stagnant waters. The apartments of dwelling-houses ought to be spacious and easily ventilated; and no dormitories for servants or buildings for the housing of cattle should be low, moist, or excluded from free and frequent circulation of the air. The temperature of inhabited apartments ought to be graduated, and ought never to rise above 64° of Fahrenheit; and the temperature of dormitories ought, as nearly as possible, to be uniform throughout the night, and ought never—as too frequently happens—to make the wide and very trying range of a rise or fall of 10° between the hour of going to bed and the hour of rising. Females ought in all cold weather to be warmly and tidily clad, and to avoid the hazardous practice of a sudden reduction of dress on a gala-day or gala-night. The use of footstoves poisons the air of rooms, induces indolent habits, and transforms healthy females into delicate and drooping invalids. A few trees around a dwelling or a farmery modify the feverish heats of summer, carry off a portion of the caloric with the moisture they exhale, and offer a degree of shade which is frequently sufficient to avert or lessen lassitude.

All seeds ought to be deposited so near the surface of the soil as to be freely fanned by the atmospheric air, and, at the same time, so far below the surface as to obtain a sufficiency of moisture for their germination. When small seeds are buried unduly deep from the air, they either utterly rot, or germinate so feebly as never to send their plumules to the surface.—Soils, when loose and pulverulent, are very bibulous of water, and readily transmit the dews which fall upon them to the roots of plants; but when they possess a compact constitution, or are unpulverized by tillage, or are skinned and incrustated by alternations of rain and sunshine, they reject most rain in multitudinous rills of surface, and permit almost all dew to be dissipated by the earliest rays of the morning sun. Hence, all land which is under drilled and hoed crops ought to be frequently stirred and kept permeable to the atmo-

sphere, and all arable land whatever ought, as fully as possible, to possess and maintain a porous condition.—All the carbonaceous, nitrogenous, hydrogenous, and oxygenous portions of manure, constituting all but a fraction of both its bulk and its value, pass by natural chemical transmutation into liquid or gaseous forms, and, if not economically used before this transmutation commences, are dissipated in the atmosphere and lost. All strictly organic manure, in fact, begins slowly to pass directly or indirectly into an aeriform state the instant its vitality ceases; and it proceeds with increasing rapidity in this process of decomposition till the whole of it becomes invisible. Carbonic acid is disengaged, and rises viewlessly into the atmosphere; nitrogen rushes into combination with hydrogen, and sends up invisible volumes of ammoniacal gas; water is formed by combination of oxygen and hydrogen, and sinks into the ground or runs off with falling rain,—in either case, to be eventually carried to the clouds in vapour; and just in the degree in which these chemical changes are permitted to occur, or in the proportion of time during which they are allowed to carry on, the manurial mass diminishes in bulk, and is robbed of its fertilizing powers. When manure undergoes decomposition in the dungyard, on the surface of the field, or otherwise in direct exposure to the atmosphere, it is wholly lost to the farmer; and only when it undergoes decomposition in a state of mixation with the soil, does it yield its elements as the food of plants.

ATOM. The term atom expresses theoretically the smallest particle of matter which is believed to be incapable of division into parts. A discussion has been carried on from ancient times relative to the finite or infinite divisibility of matter, and although the development of the atomic theory was supposed to give the strongest evidence of its limited divisibility, yet it may be fairly doubted whether the question can be decided. The divisibility of matter apparent to the naked eye, and ascertained by calculation, is almost beyond conception. Thus 0.01 of a cubic line of silver, dissolved in nitric acid, will produce a distinct milkiness in 500 cubic inches of clear water containing a trace of common salt, so that a particle of silver must be much less than the billionth of a cubic line in size. It will give a more tangible idea of a billion to say that a man counting seconds by a watch day and night would require 31,675 years. [*Kane.*] The apparent infinite divisibility of matter is more clearly shown in the minuteness of living organized beings, millions of which would be required to constitute a point visible to the naked eye; and yet they possess more or less complex systems, each part of which again is a portion of an organized structure, which may even consist of other complex parts. The mind is lost in attempting to conceive of a limit in divisibility as long as materiality enters into the idea. Again

we may divide a line into two parts, one of these divisions into two others, and we can conceive it to be infinitely divisible, for there must always be a part remaining capable of division. On the other hand, experiments of Wollaston, Faraday, &c., have been adduced in support of the limited divisibility of matter. It is found that our atmosphere has a limit of 45 miles above the earth's surface, from which Wollaston argued that if infinitely divisible, it should extend through space by infinite repulsive force and be condensed around the larger planets, such as Jupiter and the sun, forming large and dense atmospheres, recognisable by the astronomer. Such atmospheres not existing, he held that the repulsive force is limited, and that the number of repelling particles must be finite. Faraday found the vapour of bodies formed atmospheres around them of definite dimensions, and hence arrived at a similar conclusion. It is, perhaps, more advisable to adopt neither hypothesis, but to rest upon experience, for by adopting the view that matter has a limit of divisibility, we adopt a purely theoretic idea, but, at the same time, we cannot avoid making use of the term *particle* of matter, which implies limited divisibility. If, however, we employ the term *atom* as signifying a mass or collection of particles, we pass over the question entirely; and in this sense, *atom*, *atomic weight* express a mass of matter and its weight. To avoid all collision with the question, we employ the terms *equivalent*, *combining weights*, and the term *atom* as an abbreviated expression of the same.

ATOMIC THEORY. The views respecting the combination of elements in different proportions, were at first more or less hypothetical, and were the foundation of the atomic theory, which is based upon the idea of the existence of those ultimate and indivisible particles noticed in the preceding article. These views were successively developed by Bergman, Wenzel, Higgins, Richter, Mitscherlich, and Dalton; from the last of whom they received a substantial and definite form, applicable at least to the resolution of phenomena, as laws of combination. Mr. Dalton's views are unquestionably interwoven with a series of hypotheses, yet these being separated, and the term *atom* being understood, as explained in the last part of the preceding article, the so-called atomic theory becomes the expression of the fact that bodies are obedient to certain definite laws of combination; thus, for example, the quantities of alkaline bases requisite to neutralize equal weights of any one acid, are proportional to the quantities of the same bases requisite to neutralize the same weights of every other acid; and upon this law, in fact, are founded an infinite number of important theoretical deductions and practical conclusions. A second and highly curious and important fact is, that where two substances, by combining in different proportions, form two or more compounds, the second or third

proportions in which they combine, are multiples of some simple number representing the *first*. This law of multiple proportions was discovered or detected by Mr. Higgins of Dublin, about the year 1789; and it is upon this view of combination that Mr. Dalton founded his *atomic theory*, in which, assuming the existence of ultimate ponderable atoms, he regards these atoms as meeting or combining with each other according to definite laws of multiple proportion. According to this theory, bodies unite either atom to atom, or two or three atoms of one to one atom of another. Thus water is composed of an atom of oxygen and an atom of hydrogen united together; ammonia of an atom of hydrogen and an atom of azote united together; carbonic acid of two atoms of oxygen united to one of carbon. Sulphate of potash consists of a particle of sulphuric acid united to a particle of potash; supersulphate of potash of a particle of potash united to two particles of sulphuric acid. If we admit that matter is composed of atoms, as is at least probable, it is difficult to refuse admission to this hypothesis, though it is probable that more complicated cases may exist. For example, two atoms of one body may combine with three of another, and so on. It is even possible that the proportion in which bodies unite cannot always be represented by numbers. But this hypothesis of Dalton is much more probable, and corresponds much better with the phenomena, than the opposite one of Berthollet, that bodies combine in all proportions whatever. Dalton's hypothesis is very useful, because it facilitates the knowledge of the composition of bodies. For example, if water be composed of an atom of hydrogen and an atom of oxygen, it follows, from the known analysis of water, that the weight of an atom of hydrogen is to that of an atom of oxygen as 1 to 8. Hence we know, that when oxygen enters into a combination, it will always enter as 8, or as some multiple of 8. This is very observable in the metallic oxides. The quantity of oxygen in the second oxide is usually double that in the first oxide, and that in the third triple that in the first. The same thing is equally remarkable in the salts; the supersulphate of potash contains just double the quantity of sulphuric acid that exists in the sulphate, and all the supersalts contain twice as much acid as the neutral salts, with the same acid and base. Mr. Dalton assumed hydrogen as the unit or radix of his scale, on account of its being the lightest body in nature, as combining in the smallest proportions, and, consequently, as tending to a series of numbers which, for all other bodies, are multiples of itself. Wollaston and Berzelius, however, prefer oxygen as a radix, on account of its universal agency, and very frequent occurrence in compounds.

ATRAGENE. A genus of ornamental, hardy, perennial, herbaceous climbing plants, of the ranunculus tribe, recently separated from the large

and well known genus *clematis*. Five species, from Siberia, Austria, and North America, are cultivated in Britain, and grow to the height of from 8 to 15 feet.

ATRIPLEX. See ORACHE.

ATROPA. A genus of very poisonous plants, of the nightshade or potato family. The principal species is the belladonna or deadly nightshade, a perennial herb, growing wild upon accumulations of rubbish in Great Britain, and well known for both its fearfully poisonous nature, and its modern extensive use in medicine, particularly in homoeopathy. See the article **BELLADONNA**. The only other species growing in Great Britain is *Atropa arborescens*, a tender, evergreen shrub, with white flowers, and a height of 15 feet, introduced from Jamaica in 1833. But about a dozen other species have been described by botanists.

ATROPHY. A wasting away of flesh and strength in animals, caused or accompanied by inability of the digestive and absorbing organs to extract sufficient nourishment for food. There are many diseases in which the body becomes daily more lean and emaciated, appears deprived of its common nourishment, and, for that reason, of its common strength. It is only, therefore, in those cases in which the emaciation constantly increases, that it constitutes a peculiar disease; for when it is merely a symptom of other common diseases, it ceases with the disease, as being merely a consequence of great evacuations, or of the diminished usefulness or imperfect digestion of the nourishment received. But, when emaciation or atrophy constitutes a disease by itself, it depends upon causes peculiar to this state of the system. These causes are, permanent, oppressive, and exhausting passions, organic disease, a want of proper food or of pure air, exhausting diseases, as nervous or malignant fevers, suppurations in important organs, as the lungs, the liver, &c. Copious evacuations of blood, saliva, semen, &c., are also apt to produce this disease, and, on this account, lying-in women, and nurses who are of slender constitution, and those who are too much addicted to venery, are often the subjects of this complaint. This state of the system is also sometimes produced by poisons, e. g., arsenic, mercury, lead, in miners, painters, gilders, &c. A species of atrophy takes place in old people, in whom an entire loss of strength and flesh brings on a termination of life without the occurrence of any positive disorder. It is known as the *Marasmus senilis*, or atrophy of old people. Atrophy is of frequent occurrence, in infancy, as a consequence of improper, unwholesome food, exposure to cold, damp, or impure air, &c., producing a superabundance of mucus in the bowels, worms, obstructions of the mesenteric glands, followed by extreme emaciation, which state of things is often fatal, although the efforts of the physician are sometimes successful, when all the causes of

the disease have been previously removed. A local state of the same kind is sometimes produced in single limbs, by palsies, or the pressure of tumours upon the nerves of the limb, &c., and is generally curable by removing the cause.

ATROPIA. The peculiar chemical principle or alkaloid of the plants of the genus *atropa*. It may be viewed as simply a most virulent concentration of the poisonous and—when used with due care and science—the medicinal properties of belladonna.

ATTALIA. A genus of magnificent, deciduous trees, of the palm tribe. They are natives of Brazil, and grow to the height of from 10 to 70 feet. Seven species were introduced to Great Britain between 1820 and 1826, and are propagated from seeds in rich mould; but they can be raised and kept only in the stove.

ATTENUANTS. Medicines used to thin or lessen the viscosity of animal fluids.

ATTORNEY. One who is appointed by another to transact any business for him in his absence. An attorney is either public,—as those in the courts of record,—and is constituted by warrant from his client; or private,—to perform any particular act or piece of business,—who is usually appointed by letter-of-attorney.

ATTORNEY-AT-LAW. A person who manages the law-business of another, by whom he is retained; the term being analogous to the procurator, or proctor, of the civilians and canonists.

Anciently—according to the old Gothic constitution—every suitor was obliged to appear and prosecute or defend his suit in person, unless by special license from the king; and this still continues to be the rule in criminal cases. But by sundry old statutes, from that of Westm. 2, c. 10, permission was granted for attorneys to prosecute or defend any civil suit in the absence of the parties. An idiot, however, cannot, at this day, prosecute or defend by attorney, but must appear in person.

Attorneys are admitted to the execution of their office by the superior courts of Westminster hall. They are considered as officers of the respective courts in which they are admitted; on which account they enjoy many privileges; and are, on the other hand, peculiarly subject to the censure and animadversion of the judges. In order to enable one to practise as an attorney in any of these courts, he must be admitted and sworn an attorney of that particular court; and an attorney in the King's bench cannot practise in the Common Pleas, nor *vice versa*. To practise in the Court of Chancery, it is also necessary to be admitted a solicitor therein.

There are divers statutes which regulate the admission, &c., of attorneys; as, 3 Jac. I. c. 7; 12 Geo. I. c. 20; 2 Geo. II. c. 23; 22 Geo. II. c. 46; 23 Geo. II. c. 26, &c. Besides the obligation of fidelity to his client, the attorney owes him diligence and secrecy; and, in certain cases, action

lies at the suit of the client, against his attorney, for neglect of duty.

In Scotland there is no class of law-practitioners who take the name of attorneys. The office there is not public, as in England, but private; and it is constituted by letters-of-attorney. The person who receives infestment for another is also called the attorney.

ATTRACTION. The tendency, as well of the parts of matter in general, as of various particular bodies, to approach each other, to unite, and to remain united; sometimes, also, the power inherent in matter, exerting itself at the moment of approach. Experience teaches that this property is common to all matter: even liquids cohere in their parts, and oppose any endeavour to separate them. The minute particles unite into drops; drops, if they are brought in contact, into large masses. Fluids attach themselves to solid bodies, particularly to such as have very smooth surfaces, as to glass: they rise up of themselves in fine tubes, &c. Every body tends to the earth, and, if raised from its surface, falls back to it again. The plumb-line, which is usually vertical, takes an oblique direction in the vicinity of high mountains; the sea tends to the moon; the moon itself is constantly drawn towards the earth; the earth and the other planets, towards the sun. The heavenly bodies are continually subject to the simple law of mutual attraction. The Grecian naturalists speak of attraction; Copernicus and Tycho likewise admit it; Kepler's bold and comprehensive mind first hazarded the assertion that it must be universal and mutual in all bodies; Des Cartes sought to banish it entirely from natural philosophy, as one of those occult powers which he did not acknowledge; but Newton adopted it, and determined its laws, after many years of accurate observation. Fruitless attempts have been made to explain it. The phenomenon of attraction is exhibited, either in bodies that are at perceptible distances from each other, and is then called *gravitation*; or in bodies at insensible distances, taking place between their surfaces, when it is *adhesion*; or uniting their component parts, when it is *cohesion*. We cannot enumerate all the particular subdivisions of attraction, but the most important are those of chemical affinities and magnetic and electric attractions.

ATTRACTION (CHEMICAL). See **AFFINITY**.

AUBRIETIA. A genus of ornamental, evergreen, herbaceous, hardy, trailing plants, of the cruciferous family. The species are three in number, about three inches in height, producing purple flowers from March till June; and are very common in all sorts of gardens. They were but recently erected into a genus, and formerly belonged to the genera *alyssum*, *arabis*, and *draba*.

AUCHENIA. See **ALPACA**.

AUCUBA JAPONICA. A beautiful evergreen shrub, apparently of the buckthorn tribe. It

usually grows to the height of about six feet; its leaves have some resemblance in shape, size, and texture, to those of the laurel, but are larger, less fleshy, more pointed, and profusely blotched with a lightish-yellow or creamy white; and its flowers are apetalous, and appear in May and June. It was introduced to Great Britain from Japan in 1783; and it required, for some time, to be treated as a tender plant; but it is now quite hardy, and has become one of the most widely diffused, as it is decidedly one of the most handsome, members of our shrubberies. It belongs to the Linnæan class, *Diacia tetrandria*, whose female flowers are produced on different plants from the male flowers; and only the female plants of aucuba appear to have yet been introduced to Great Britain. But these are easily and multitudinously propagated in the nurseries, by means of cuttings in any ordinary garden soil.

AUGER. An implement for boring. Small-sized augers are used by several classes of handicraftsmen, particularly by carpenters and other workers in timber; but large-sized augers are used for boring the ground, in order to ascertain the character of subsoil, to discover springs, to make artesian wells, to draw off water from land, to assist certain operations of draining, and to search for coals and other strata of useful minerals. An auger for trying subsoil should be about an inch in diameter; its bit should be large; its summit should be provided with a transverse iron handle, for wringing the bit into the ground; and on piercing every successive depth of six inches, the implement should be drawn up to cleanse the bit, and examine the specimen of soil or subsoil which it contains. An auger for this work may have a length of ten feet, six feet, or only three feet, according to the depth at which the subsoil is to be tried. An auger for very deep boring, whether to assist draining operations, or to search for springs or minerals, consists of a wimble or shell, and a series of rods. The wimble is usually from $2\frac{1}{2}$ to $3\frac{1}{4}$ inches in diameter, and about 16 inches in the length of its hollow; and, except that its sides come closer to one another, it is constructed in nearly the same manner as the wimble used by carpenters. The rods are each about four feet in length, and one inch in diameter; they screw into one another to any desired length of a series; and, to assist their united strength, they are made $1\frac{1}{2}$ inch thick at the joints. But when any stratum of rock or other very resisting material is to be pierced, either a punch or a chisel is used instead of the wimble,—the punch of the same thickness as the rods, and with a sharpened point,—and the chisel an inch or $1\frac{1}{2}$ inch broad at the face, and kept very sharp in the edge. Boring to assist draining operations ought never to be practised till after the drain is cut, and ought to have for its object simply the perforating of any retentive stratum which lies

between the bottom of the drain and the strata containing the spring. See articles DRAINING and ARTESIAN WELLS.

AUGUST. See CALENDAR.

AURACARIA. A genus of evergreen, ornamental, timber trees, of the cone-bearing tribe. A tree of the imbricated species, *Auracaria imbricata*, is a noble object, most exotic in appearance, and far more curious and arresting than any other exogenous tree with which we are acquainted. It naturally graces the more southerly plains of South America; it was introduced to Great Britain from Chili in 1796; it was at first of decidedly tender habit, but is becoming accustomed to our climate; and it promises to be, in a few years, very extensively diffused, and to impart a new and very interesting feature to our shrubberies and woods. It usually attains, in its native country, a height of 150 feet, but figures exceedingly well with us as a tall shrub; it has the same kind of pyramidal outline and horizontal ramification which distinguishes the firs and the cedars; and its leaves are so remarkably imbricated as to appear like edgy and angular convolutions along the branches. Some botanists, but not with general consent, have called it *Columbea quadrifaria*.—The Brazilian species, *Auracaria Braziliensis*, was introduced to Great Britain from Brazil in 1819, and usually attains in its native country a height of about 100 feet; but as yet is of very tender constitution in our climate.—The tall species, sometimes called the Norfolk Island pine, *Auracaria excelsa*, and another species called Cunningham's, *Auracaria Cunninghami*, have recently been erected into a separate genus under the name of *Altingia*, yet will, for some time, continue to be better known as auracarias. The Norfolk island species is, beyond all question, one of the most beautiful and magnificent trees in the world; it attains, on Norfolk island, a height of upwards of 200 feet, and a magnitude of corresponding stupendousness; it displays a symmetry and an elegance, which would grace any pot plant of the greenhouse; and even the few dwarfish specimens of it which grow within the narrow limits of our conservatories, though poor and pitiful representatives of the massive and soaring tree, instantly arrest the eye as the very beau ideal of dendritic beauty. This species was introduced to Great Britain from Norfolk island in 1796.—The Cunningham species is very much smaller than the preceding, and was introduced to Great Britain from New Holland in 1824.—All the species of auracaria are raised in frames, from seeds, in a mixture of peat and loam; but young plants, especially of *Auracaria imbricata*, may readily be obtained at the public nurseries.

AURANTIUM. The sweet orange-tree, or *Citrus aurantium*. See ORANGE. The aurantium, though only a species, forms the type of the natural order aurantiaceæ. The number of genera in this order is eleven; and the number of spe-

cies cultivated in Great Britain is about thirty-two; but all are so tender as to require either the hothouse or the greenhouse. Most of the species bear a close resemblance to the orange-tree and the lemon-tree; their leaves are thick, articulated with the footstalks, and replete with fragrant oil; their flowers are odoriferous; their fruit is fleshy, and generally eatable; and their timber is very close-grained.

AURICULA,—botanically *Primula auricula*. A well-known small, evergreen, herbaceous, flowering-plant, of the primrose genus. It was formerly called *Auricula ursi*, or bear's ear; but is now universally recognised as a primula, and popularly known as the auricula. Though so very common as to be seen in almost every cottage garden, it retains favour with the most fastidious flower-fanciers, holds everywhere the rank of a florist's flower, and is, in fact, an universal favourite. It is a native of Switzerland, and was introduced to Great Britain in 1596. Four well-established or quite permanent varieties are known to botanists, called *lutea* or the yellow, *calycantha* or the coloured-calyxed, *integerrima* or the most entire, and *hortensis* or the garden-variety; but the number of tolerably distinct varieties is very great, and that of fugitive varieties is, for any thing we know, almost infinite. Every year, since the date of cultivation by artificial sowing, appears to have produced vast numbers of new varieties, differing from one another in the shape, size, and disposition of the leaves, and especially in the shape, size, and colour of the flowers; and very frequently the varieties which are most admired when they first appear, are disesteemed, neglected, and consigned to extinction in the course of a few years. In fact, the same childish and capricious fashion which always regulates the cut of ladies' dresses, and which has of late years luxuriated among the sportings of the hybrid violet, the calceolaria and the dahlia, and which formerly attempted to dictate to the sportings of the hyacinth, the anemone, and the tulip, has, for upwards of a century, alternately patronized and banished thousands of varieties of the auricula. But to any florist, whose taste is natural, and spurns the dictum of caprice, a most beautiful and ever-pleasing collection of auriculas may very easily be obtained. Miller, whom all old florists still regard as an oracle, states, as the characters of a good auricula,—that the stem of the flower should be lofty and strong,—that the footstalk of the flower should be short, and the umbel regular and close,—that the pipe or neck of each flower should be short, and the flowers large, regularly spread, and not inclinable to cup,—that the colours be very bright and well-mixed,—that the eye of the flower be large, round, and of a good white or yellow,—and that the tube or neck be not too wide. The flowers appear in April and May; and, when tolerably well assorted as to colours, have a most joyous appearance in

the little flower-plots of the cottage, or the small flower-gardens of the farmery,—more so, to our taste, than when they fill beds or stages in the most luxurious modes of horticulture. Amateur florists and high fancy gardeners, in order to procure the finest possible blooms, practise scores of niceties in the culture of the auricula; but any cottier may propagate a good plant, and maintain it in very nearly the best flowering condition, simply by lifting it in the first week of every August, cutting it into two or three by vertical sections of the root, and transplanting the parts into good garden soil, enriched with tolerably strong and well-rotted manure. Propagation from seed is requisite, of course, for new varieties; but is so troublesome and tedious as to be a proper employment for only the amateur or the regular practical gardener.

AURORA BOREALIS. We often see in the north, near the horizon, usually a short time after sunset, a dark segment of a circle, surrounded by a brilliant arch of white or fiery light; and this arch is often separated into several concentric arches, leaving the dark segment visible between them. From these arches, and from the dark segment itself, in high latitudes, columns of light, of the most variegated and beautiful colours, shoot up towards the zenith, and, sometimes, masses like sheaves of light are scattered in all directions. The appearance is then splendid; and its increasing beauty is announced by a general undulation of the masses of light. A kind of fiery coronet is afterwards formed about the zenith, by the meeting of all the columns of light, resembling the knob of a tent. At this moment, the spectacle is magnificent, both for the multiplicity and beauty of the columns which the aurora presents. The light, after this, grows fainter and more tranquil. This faintness and tranquillity, however, are only temporary, for the phenomena are soon repeated in all their beauty—the oscillation of the columns of light, the formation of the corona, and the like, though with a thousand variations. At length, the motion wholly ceases, the light is collected about the northern horizon, the dark segment vanishes, and nothing is left but a strong brightness in the north, which is lost in the dawning day. These brilliant appearances are also attended, in high latitudes, with loud noises, described as resembling the hissing and crackling of fire-works. This appearance has received the name of *northern light*, because, on account of our position on the earth, we see it only about the north pole. A similar appearance, *aurora australis*, was seen about the south pole, in 1773, by Cook's sailors, between 58° and 60° S. lat., and later travellers have observed the same. These phenomena ought, therefore, properly to be called *polar lights*.—Philosophers are of different opinions as to the cause of the aurora. It is, however, satisfactorily ascertained to be within the region of our atmosphere. Hell as-

cribed it to the reflection of the sun and moon by the clouds of snow and needles of ice, which are constantly floating in the atmosphere of the frigid zones. Mairan supposed it to proceed from the atmosphere of the sun. Bailly ascribed it to magnetism, and its remarkable influence on the needle has been generally observed. Franklin attributed it to electricity. Biot, who was sent to the Shetland islands, in 1817, by the French academy of sciences, to determine the length of the pendulum vibrating seconds, had an opportunity, August 27th of the same year, of observing the aurora borealis, in all its splendour, at the island of Unst. On this occasion, he ascribed to the phenomenon a volcanic origin, and his reasoning is given at length in the 'Journal des Savans' for 1820. His description of this wonderful phenomenon is to be found in Biot's 'Précis Élémentaire de Physique,' 3d edit., Paris, 1824, vol. ii. p. 99, et seq. An ingenious hint of Kästner, advanced in the sixth edition of Gren's 'Physik,' Halle, 1820, is deserving of attention. He considers polar lights as the electricity of the earth rising periodically to the poles. Some interesting observations on this appearance were communicated by Richardson and Hood, in the appendix to Franklin's 'Narrative of a Journey to the Shores of the Polar Sea, in 1819,' &c. London, 1823, 1824. Notwithstanding the attention which has been paid to the phenomena of the aurora borealis, and the various hypotheses which have been imagined to explain them, it will be found that there is a want of information on the points which are most necessary as bases of induction; and the British Association have therefore been induced to appoint a committee in the express view of directing observers to the really important features of this meteor, and of obtaining, by a system of contemporaneous observation, data which experience shows cannot be derived from insulated exertion.

The following are the most important points which demand the attention of observers:—

1. The elevation of the auroral arches and streamers above the surface of the earth.
2. The determination of the question whether the auroral exhibition is accompanied by sound.
3. The existence of recurring periods of frequency and brilliancy in the aurora.
4. The influence of arches, streamers, and other auroral phenomena upon the magnetic needle.

AUTUMN. See SEASONS.

AVENA,—popularly *Oat-grass*. A large and important genus of grasses, forming the type of the suborder Avenaceæ or oatlike grasses. This suborder comprises the genera *avena*, *danthonia*, *trisetum*, *trichæta*, *deschampsia*, *ammophila*, *corynephorus*, *arrhenatherum*, *holcus*, *hierocloe*, *aira*, *peribalia*, *melica*, *airopsis*, *schismus*, *triodia*, *phragmites*, *arundo*, and *arundinaria*. The genus *Avena*, as formerly constituted, and as still understood by many botanists, includes some species which have recently been assigned to five or

six of these genera: yet, independently of these species, it comprises about forty known species, seventeen of which are either indigenous in Great Britain, or have been introduced from foreign countries. We shall, for the sake of convenience, treat the genus as still including the few species which have been assigned to other genera; and, thus understood, the portion of it which exists in Britain comprises five species which are cultivated as grain, three species which are valuable as forage-grasses, and several species which challenge attention only as weeds.

The short oat, *Avena brevis*, is an annual cereal grass, introduced from Germany in 1804. It grows to the height of only about 9 inches; and its seeds are small but numerous. It is cultivated, for the sake of its seeds, in the central uplands of France, and in other districts.—The bristle-pointed oat, *Avena strigosa*, but now called *Danthonia strigosa*, grows wild, as an annual weed, in the hedges of Great Britain; yet is sometimes cultivated for its seeds in the remoter districts of the Scottish Highlands. A variety of this species is known to British agriculturists, under the name of the Argyleshire small oat.—The eastern or Tartarian oat, *Avena orientalis*, is an annual grass, grows to the height of three feet, and was introduced to Great Britain in 1798. It is distinguished from the common oat by its panicle being contracted and nodding to a side. In its ill-improved or comparatively wild state, it is awned and blackish in colour; but it greatly improves, and becomes awnless and white, by cultivation in a good soil. It is cultivated as a cereal grass, partially in Britain, and largely in some districts of continental Europe. Three varieties of this species are known to British agriculturists, under the names of black Tartarian oat, common white Tartarian oat, and early white Tartarian oat.—The naked oat, *Avena nuda*, is distinguished from the other cultivated species, by having the corolla detached from the seed, in the same manner as wheat and naked barley; and, on this account, it is often popularly called pilcorn or peelcorn. It has been cultivated from time immemorial in Europe; it is mentioned by our earliest writers; and it was, at one time, in general cultivation throughout Scotland and some parts of England. A variety of this species is known to some farmers under the name of the small naked oat.—The common oat, *Avena sativa*, is incomparably the most important species, and it has sported itself into numerous valuable varieties, which constitute emphatically the *oats* of agriculture. Two permanent varieties, the blackseeded and the white-seeded, or *melanosperma* and *leucosperma*, are recognised by botanists; and about forty distinct and rather conspicuous varieties are known to the most intelligent class of British agriculturists, and have been classified into the three divisions of thin-skinned white oats, large thick-skinned white oats, and dark-coloured oats. The thin-

skinned white varieties constitute much the largest and most important division, and nearly correspond to the *Avena leucosperma* of botanists; the large thick-skinned white varieties amount to only five or six, and have been called by some botanists *Avena Georgica*; and the dark-coloured varieties amount to only six or seven, and have been called by some botanists *Avena cinerea*. But we reserve all practical notice of this great subject for the article OATS.

The yellow or golden oat-grass, *Avena flavescens*, now called *Trisetum flavescens*, is a perennial weed of Great Britain, growing to the height of about 18 inches; and, if attempted to be cultivated by itself, it will not thrive; yet it prospers, and is well worthy of cultivation, in mixture with some other grasses for either hay or pasture; it is the most useful of all the oat-grasses for forage; it arrives early at maturity, and yields a considerable bulk of fine herbage; and it has the smallest seed of all the oat-grasses which are indigenous in Britain. The grasses with which it suits best to be combined are *Cynosurus cristatus*, *Anthoxanthum odoratum*, and *Hordeum pratense*. It occurs in the richest natural pastures, and is found wild in almost every kind of meadow; but it thrives best, as an artificial grass, on dry calcareous soil. It is peculiarly suitable to lofty and exposed situations; for it prospers on them better than most other grasses, and is quite as readily devoured by sheep. It contains in its nutritive elements a larger proportion of bitter extractive than occurs in the nutritive elements of the grasses with which it is usually combined; and, on that account, is an important ingredient in the herbage of rich pasture land. Though a perennial grass, it speedily dies out if allowed to bear seed. It usually flowers in the first and second weeks of July, and ripens its seed in the beginning of August. When grown upon clayey loam, it yields per acre, when in flower, 8,167½ lbs. of green produce, 2,858½ lbs. of dry produce, and 478½ lbs. of nutritive matter,—when its seed is ripe, 12,251½ lbs. of green produce, 4,900½ lbs. of dry produce, and 430½ lbs. of nutritive matter,—and when in aftergrass, 4,083½ lbs. of green produce, and 79½ lbs. of nutritive matter.

The meadow oat-grass, *Avena pratensis*, is a perennial native of the pastures and meadows of Great Britain, and usually grows to the height of about a foot; but it is much less common than either the yellow oat-grass or the downy oat-grass. It occurs on a greater variety of soils than most other kinds of grasses,—on dry heaths, in moist meadows, on sandy loams, and in chalky fields; but is most frequent and abundant on the last of these kinds of soils. It thrives under irrigation, and exhibits a greener and more healthy-looking foliage on meadows than on dry elevated soils; yet it yields quite or very nearly as great a produce on these soils as on an irrigated meadow. Its nutritive elements contain a smaller proportion of extractive and saline matters than

those of the other herbage species of oat-grass; and its aggregate character, habits, and produce assign to it a lower place in the scale of economical value than belongs to either the yellow oat-grass or the downy oat-grass. It flowers in July, and ripens its seed in August. When grown upon sandy loam, it yields per acre, when in flower, 6,806½ lbs. of green produce, 1,871½ lbs. of dry produce, and 239½ lbs. of nutritive matter; and when its seeds are ripe, 9,528½ lbs. of green produce, 2,858½ lbs. of dry produce, and 149 lbs. of nutritive matter.

The downy oat-grass, *Avena pubescens*, now called *Trisetum pubescens*, is a perennial native of the chalky pastures of England, and naturally grows to the height of about eighteen inches. But it deserves the attention of the farmer on account of its hardiness, and of its being but a slight impoverisher of the soil; and when it is cultivated as an artificial grass, in tolerably rich soils, it attains a greater height than when growing wild, and loses the downy hairs which cover its leaves when growing upon poor, dry, chalky grounds. After its first flowering culms are cropped, it does not send forth any more, and, on this account, is well suited for permanent pasture on such dry soils as are easily impoverished. But its nutritive elements contain a greater proportion of bitter extractive than those of other grasses which are suited to such soils; and, for this reason, it ought not to be a large ingredient in any mixture of grasses for permanent pasture on these soils. It flowers in the second or third week of June, and ripens its seed about the beginning or middle of July. When grown upon sandy loam, it yields per acre, when in flower, 15,654½ lbs. of green produce, 5,670½ lbs. of dry produce, and 367 lbs. of nutritive matter; and when its seeds are ripe, 6,806½ lbs. of green produce, 1,361½ lbs. of dry produce, and 212½ lbs. of nutritive matter.

The tall oat-grass, *Avena elatior*, also called *Holcus avenaceus*, and now fixed in the newest systematic botany as *Arrhenatherum avenaceum*, is a perennial native of the meadows and pastures of Great Britain, and usually grows to the height of about five feet; and though a coarse plant, it vegetates with luxuriance, and has been permitted a place among the agricultural grasses. Yet it contains but a comparatively small portion of nutritive matter; and is ill relished by cattle, and much disliked by horses.—The barren, fly, or animated oat, *Avena sterilis*, is an annual grass, and was introduced to Great Britain from Barbary in 1640. It is interesting chiefly as a curiosity; its ripe seeds having a form somewhat like a fly, and being so exceedingly mobile as to seem at a little distance as if animated.—The alpine oat-grass, *Avena alpina*, or *Avena planiculmis*, now called *Trisetum alpinum*, grows wild on the Scottish mountains, is a perennial grass, and has a height of about 18 inches.—The insipid oat-grass, *Avena fatua*, is an annual weed of the corn-fields

of Britain, and grows to the height of four feet.—The early oat-grass, *Avena præcox*, formerly called *Aira præcox*, is an annual weed of the heathy grounds of Britain, and usually grows to the height of about six inches.—All the other species of *avena* are exotics, devoid of any interest to the British farmer.—*Sinclair's Hortus Gramineus Woburnensis*.—*Prize Essays of the Highland Society*.—*Loudon's Hortus Britannicus*.—*Davy's Agricultural Chemistry*.—*Miller's Dictionary*.—*Useful Knowledge Society's British Husbandry*.—*Law's Elements of Practical Agric.*—*Sproule's Treatise on Agriculture*.—*Catalogue of the Highland Society's Museum*.—*Lawson's Agriculturist's Manual*.

AVENS,—botanically *Geum*. A genus of ornamental, perennial, hardy, herbaceous plants, of the rose family. About forty species are known to botanists; and upwards of twenty of these are cultivated in the gardens of Great Britain. The common or city species, *Geum urbanum*, is often popularly called herb-bennet, and has long held a place among the medicines of herbalists. It grows plentifully in woods and by the sides of hedges, in most parts of Britain; and, in consequence, is rarely admitted to gardens. Its stem grows to the height of 1½ or two feet; its leaves are heart-shaped; its flowers are yellow and erect, and appear from May till August; and its roots consist of a main stem, and many strong brown fibres. The roots are aromatic and astringent; they yield an agreeable clove-like flavour, when infused in wine or beer; and they have given rise to the botanical name of the whole genus, which signifies 'a relish.' The herbage is greedily devoured by sheep, and, when young, may be used for salad and other culinary purposes; the dried root, if placed in a bag and hung in a cask of beer, is said to have the power of preserving the beer from souring; and the powder of the root is cephalic and alexipharmic, and has been successfully employed, in conjunction with Peruvian bark or quinine, in cases of diarrhoea, dysentery, ague, and intermittent fever.—The river species, *Geum rivale*, grows wild in moist woods and moist meadows, especially in mountainous countries, and is somewhat common throughout Great Britain. Miller calls it aquatic herb-bennet, with a nodding flower. Its stem has a height of 12 or 15 inches; its lower leaves have two pairs of small lobes at the bottom, and three large ones at the top, that which terminates being the largest; its upper leaves have three acute lobes, and sit close to the stalk; and its flowers are of a purplish or brownish-red colour, appear in June and July, and are readily distinguished from those of the city species by their nodding or drooping position. A permanent variety of the river species has the name of intermediate.—All the other species are foreign, and have been introduced from Kamtschatka, Germany, the Pyrenees, Russia, the south of Europe, Chili, and principally North America. Those

chiefly admired and most frequently to be met with are the species denominated *album*, *strictum*, *agrimonoides*, *hybridum*, *pyrenaicum*, *montanum*, *reptans*, and *chiloense*.

AVENUE. A walk, a park road, or an approach to a mansion, planted along both sides with trees. Avenues were at one time so common in the parks or pleasure-grounds of Great Britain, that almost all mansions had one or more, while some had as many as there were views from the house. But a better taste has now, for a long period, prevailed; and even Miller, writing eighty years ago, remarked, "Nothing can be more absurd than to have the sight contracted by two or more lines of trees, which shut out the view of the adjacent grounds, whereby the verdure and natural beauties of the country are lost; and where the avenues are of a considerable length, they appear at each end to be only narrow cuts through a wood, which never can please any person of real taste; and when the road to the house is through the avenue, nothing can be more disagreeable; for in approaching to the house, it is like going through a narrow lane, where the objects on each side are shut out from the view; and when it is viewed from the house, it at best has only the appearance of a road, which, being extended to a length on a straight line, is not near so beautiful as a common road, which is lost by the turnings, so as seldom to be seen to a great extent. But as these avenues must be made exactly straight, so when the trees are grown to any size, they entirely break the view, whatever way the sight is directed through them; and if this is in a park, the lawn of grass through which the avenue is planted, is thereby entirely deprived of the beauty which it naturally would afford, if left open and well kept. Therefore, whenever the situation of a house will admit of a large open lawn in front, the road to the house should be carried round at a proper distance; and if it be carried sometimes through trees, and serpented in an easy natural way, it will be much more beautiful than any stiff formal avenue, how large soever made."

But as avenues are still occasionally planted, a brief notice of the kinds of trees most suitable for them may possibly be of some use. The English elm will suit in all soils, except the very wet and the shallow; and it is preferred to all other trees on account of its stateliness, its fine outline, and its easy capability, without any injury, of any kind of heading, lopping, or cutting. The rough Dutch elm—so very eligible for hedges and for lofty espaliers—grows quickly, bears removal well, and carries its foliage from an early to a late period of each season, and, for these reasons, is sometimes preferred to the English elm. The lime is valued for its regular growth, its beautiful foliage, its elegant outline, and its fine shade. The horse chestnut is esteemed for its magnificent exfoliation, its superb flowers, and its massive and imposing outline, and is suitable for all

places which are not exposed to rough winds. The common chestnut, when growing isolatedly, is inclined rather to spread than to grow tall; but, when planted in close lines or clumps, and upon good soil, it rises to a considerable height, and has an agreeable appearance. The beech, though a beautiful tree, and though growing well in Britain as a spontaneous production, is very liable to serious injury from transplantation, and, on that account, is not suitable for avenues. The oak might in some respects serve exceedingly well for avenues, but is of far too slow a growth. The albe has bad habits, and is very far from being a handsome tree; yet it is eminently suitable on spongy soils, or when the chief consideration is rapid growth. The alder, the ash, the plane, and the sycamore, have been but rarely used for planting avenues.

The only method of planting avenues, for many an age, was simply to place the trees in regular rows, at regular distances; and when any attempt was made at a very imposing effect, the principal device adopted was to plant two rows on each side of the walk, and to select for the outer rows a taller and more massive tree than was used for the inner rows. But about 100 or 120 years ago, a new and more magnificent method was introduced. This method consists in planting the trees in clumps or platoons, making the opening much wider than in the old method, placing the clumps about 300 feet distant from one another, and assigning to each clump seven or nine trees. When this method is practised, the trees in each clump should be planted 30 feet distant from one another, and a ditch and fence should be formed round each clump, to prevent the barking of the trees by deer. But the old method of single regular rows is far preferable for all short walks; and the method of lines of clumps is best suited for very long walks through great and magnificent parks. As to the miserable abortions which take the name of avenues in the approaches to some villas and farmeries, and which consist of some score or two dozen of willows, poplars, or Scottish pines, they cannot, as avenues, be too soon or unsparingly made acquainted with the woodman's axe. A few trees about even the meanest country place, are always pleasant, and may generally be useful; but by all means let a little taste be exercised in choosing the kinds, and fixing the arrangement.

AVERAGE. The medium between two extremes, or the mean of several sums. But it is used in various technical senses in commerce; and, in particular, it has a peculiar sense in the corn-trade. In 1770, it was enacted that the justices at quarter-sessions should order returns to be made weekly of the price of corn, from not less than two or more than six towns in each county, to a receiver of corn returns, appointed by the lords of the treasury, who was directed to publish an abstract of such returns weekly, in the London Gazette. The first of these weekly

averages appeared in the Gazette of Nov. 24, 1770. In 1781, it was enacted that the prices for regulating *exportation* should be determined by the averages of the London Corn-exchange; and, in 1789, England and Wales were divided into twelve districts, in each of which the justices of the peace were directed to appoint persons to ascertain the prices of corn at the seaports and principal market-towns, and to make returns thereof weekly to the receiver in London, who, on the first day of February, May, August, and November, was to ascertain the average of the previous six weeks,—except as to oats, the price of which was to be taken on an average of twelve weeks. The averages thus ascertained were sent to the customs' officers in each district to regulate the importation for the ensuing three months; but exportations were still regulated by the average tables weekly. In 1791, the number of districts in the kingdom was increased by adding Scotland, and dividing it into four districts; but the districts themselves were still kept separate, and the distinction between averages for regulating exports, and those for fixing the duties on imports, was retained. In 1804, the returns from all England were directed to be taken together, and one average price struck; and the same was done in the case of Scotland; and in the following year one average price was adopted in England and Scotland for both imports and exports. In 1815, the celebrated Corn-law enacted that the averages should be fixed every three months upon the prices of the previous six weeks, and should continue the same until the expiration of the quarter. See article **CORN-LAWS**.

The following table of the average price of wheat in England, and at Dantzic, from 1746 to 1846, will be acceptable to many readers:—

YEAR.	Annual Aver. Price of Wheat in England and Wales, per Winchester Qr., down to 1770, and per Imperial Qr. subsequently.		Annual Aver. Price of Wheat at Dantzic, per Winchester Qr., down to 1821, and per Imperial Qr. subsequently.	
	s.	d.	s.	d.
1746	34	8	25	1
1747	36	11	24	2
1748	32	10	21	1
1749	32	10	22	8
1750	28	10	20	8
1751	34	2	20	7
1752	37	2	22	3
1753	39	8	21	6
1754	30	9	19	1
1755	30	1	18	4
1756	40	1	23	1
1757	53	4	31	0
1758	44	5	29	0
1759	35	3	23	7
1760	32	5	19	0
1761	26	10	19	4
1762	34	8	21	10
1763	36	2	—	—
1764	41	6	22	3
1765	48	0	25	1
1766	43	1	26	6

	s.	d.	s.	d.
1767	57	4	27	11
1768	53	9	32	3
1769	40	7	29	10
1770	43	6	23	4
1771	48	7	31	6
1772	52	3	33	8
1773	52	7	35	8
1774	54	3	32	1
1775	49	10	33	11
1776	39	4	27	6
1777	46	11	22	4
1778	43	3	23	9
1779	54	8	21	10
1780	36	9	19	4
1781	46	0	24	9
1782	49	3	26	3
1783	54	3	27	5
1784	50	4	28	10
1785	43	1	30	2
1786	40	0	29	2
1787	42	5	—	—
1788	46	4	29	1
1789	52	9	43	8
1790	54	9	40	4
1791	48	7	30	9
1792	43	0	29	0
1793	49	3	32	0
1794	52	3	36	0
1795	75	2	57	9
1796	78	7	54	3
1797	53	9	33	1
1798	51	10	32	10
1799	69	0	46	10
1800	113	10	73	9
1801	119	6	78	11
1802	69	10	53	5
1803	58	10	46	3
1804	62	3	53	3
1805	89	9	69	10
1806	79	1	58	6
1807	75	4	—	—
1808	81	4	—	—
1809	97	4	42	10
1810	106	5	53	4
1811	95	3	36	3
1812	126	6	—	—
1813	109	9	—	—
1814	74	4	47	5
1815	65	7	46	1
1816	78	8	57	4
1817	96	11	75	8
1818	86	3	64	7
1819	74	6	43	9
1820	67	10	33	3
1821	56	1	31	7
1822	44	7	29	1
1823	53	4	26	8
1824	63	11	22	9
1825	68	6	23	3
1826	58	8	23	1
1827	58	6	26	11
1828	60	5	37	1
1829	66	3	47	1
1830	64	3	42	2
1831	66	4	46	3
1832	58	8	38	0
1833	52	11	30	7
1834	46	2	27	6
1835	39	4	23	8
1836	48	6	28	11
1837	55	10	29	8
1838	64	7	44	1
1839	70	8	46	5
1840	66	4	50	10
1841	64	4	51	4
1842	57	3	—	—

	s.	d.	s.	d.
1843	50	1	—	—
1844	51	3	—	—
1845	55	10	—	—

The following are the official average prices of wheat in France for the month of December in each year, from 1819 to 1838, the whole reduced into English measure and money:—

	Per Hectolitre.	equal to	Per Quarter.
	14f. 8½c.	..	31s. 1d.
1819	..	19 90	.. 45 7
1820	..	14 98	.. 34 3
1821	..	16 8	.. 36 9
1822	..	15 67	.. 35 10
1823	..	15 1	.. 34 4
1824	..	15 53	.. 35 6
1825	..	15 90	.. 36 5
1826	..	21 67	.. 49 7
1827	..	22 91	.. 52 6
1828	..	21 5	.. 48 2
1829	..	22 25	.. 51 0
1830	..	22 18	.. 50 10
1831	..	18 0	.. 41 3
1832	..	14 87	.. 34 1
1833	..	15 62	.. 35 9
1834	..	14 68	.. 33 9
1835	..	17 32	.. 39 8
1836	..	17 92	.. 41 6
1837	..	22 49	.. 51 6
1838	..	—	.. —

The average of the whole period is 17f. 94c. per hectolitre, which is equal to 41s. 1d. per quarter.

To compare the average prices of wheat in France with those of England and Wales, it is necessary to add 20 per cent. to the latter for difference in the quality of the wheat and the difference in the mode of taking the averages.

AVERRUNCATOR. A pruning instrument. Two blades are fixed on the end of a rod; and, by means of a line attached to one of them and pulled by the operator, they act like scissors.

AVIARY. A structure devoted to the feeding and propagating of birds. It ought to be spacious enough to allow the birds a considerable freedom of flight, and turfed to prevent the appearance of foulness on the floor. "The site of an aviary," says a writer in the Quarterly Journal of Science, vol. xxv., "should be facing the south or west, and sheltered from the north and east. It should be principally open to the air, and should be constructed of wire almost entirely; but there is no objection, indeed it is rather desirable, that some parts of it should be covered with a roof affording shelter in winter, and shade in summer. A constant supply of fresh, and, if possible, running water, is exceedingly necessary for the health and comfort of the little inmates. The aviary should be well covered all over with turf, excepting the walks, which should be gravel. The perches should be most of them over the walks, for the facility of cleaning; and ample cover should be afforded by evergreens, such as the phyllerea, ilex, holly, laurel, Portugal laurel, laurustinus, yew, box, cypress, &c. If deciduous trees be planted, the leaves will soon be picked off, and the buds destroyed. If it should be intended to include foreign as well as native birds in the aviary, it should be so constructed as to be capable of being heated in the winter; and the best mode of doing this would be to have the aviary fronted with glass four or five feet from the wires, and the space between ornamented with plants, both because they would

afford the best test of a proper temperature being maintained, and also this would combine the sources of gratification and amusement. Should only a few foreign birds be admitted, separate apartments may be so constructed, as to communicate with the aviary in the summer, and to be shut up and warmed with a flue in the winter. Birds are either carnivorous, granivorous, or insectivorous. The first class are not fitted for the aviary—the second always do well—the third require great care to keep them in health. I have found that the best food for constant supply is buck wheat, hemp, rape and canary seeds, and a mixture of barley meal and grated liver. The latter is particularly necessary for the lark tribe and the sylvias, and also for the merulidæ. Snails, slugs, and worms, should be frequently supplied also; and green food, such as groundsel, chickweed, lettuce, and water-cresses; also the seed of plantain, dock, and thistles occasionally. The seed should be provided in boxes, so constructed that a little only should fall down at a time. There should be several boxes, as the stronger birds are apt to tyrannize over the weaker, and keep them from their food; and each of the boxes should have several divisions of wire, or wood."

AVOIRDUPOIS. The distinguishing denomination of British commercial weight. The term is probably derived from *avoirs*, the ancient name for goods or chattels, and *poids*, weight. By act of parliament, Geo. IV. cap. 74, it is directed that while the troy pound or standard-weight shall contain 5,760 grains, the avoirdupois or common pound shall contain 7,000 such grains; and that 10 pounds avoirdupois, or 277·274 cubic inches of distilled water at 62° Fahrenheit, the barometer being at 30 inches, shall be the contents of the new Imperial gallon. By the new act which came into operation on the 1st of January, 1835, with the exception of gold, silver, platina, precious stones, and drugs, when sold by retail, all articles are to be sold by avoirdupois weight. The avoirdupois pound is divided into 16 ounces of 16 drams each: the dram containing 27½ grains. Its multiples are quarters of 28 pounds each; hundred-weights of 4 quarters each; and tons of 20 hundred-weights each.

AWLWORT,—botanically *Subularia*. A curious annual aquatic plant, of the mountain lakes of Great Britain. It belongs to the cruciferous tribe, and takes both its popular and its botanical names from the awl-shaped form of its leaves. It grows about 3 inches high, and flowers in July. The only known species is *Subularia aquatica*.

AWNS. The beards or long bristles which project from the chaffs or exterior of the seeds of barley, spring wheat, and some other grasses. In some parts of England they are called ails.

AXE. A well-known tool, in almost constant requisition by the forester, the woodsman, the wheelwright, the house-carpenter, and all other operators upon timber. An axe is an indispen-

sable tool on a farm for many miscellaneous purposes, and ought to occupy a very accessible place in the tool-house of the farmery.—A suggestion was made, about 12 years ago, by a gentleman in Dublin, that a very facile kind of battering-axe might be advantageously employed for felling timber trees. The general mounting and mode of working are a miniature of those of the ancient battering-ram. The blade is made like a large socket, or like the Irish 'feck' spade, and spiked to the wood; transverse bars are inserted in the shaft, to the number of two, three, or four, according to the number of workmen to be employed; the axis of the battering-axe above is long enough to allow the side-frames to be placed nearer or more remote, according to the size of the tree; and a diagonal stay-bar is dropped upon, and prevents all from falling sideways. A totally different kind of implement for the same purpose will be noticed under the word **FELLING-SAW**.

AXIL, or AXILLA. The angle which the leaf-stalk of a plant forms with the part of the stem or branch above it.

AXLE. The bar which connects the two wheels of a two-wheeled or a four-wheeled vehicle, and on which the body of the vehicle is supported. See article **CART**.

AXONOPUS. A small genus of exotic annual grasses, of the millet tribe. Two uninteresting and very tender species, the digitate and the golden, were introduced to Great Britain from the West Indies in 1820 and 1821; and a curious hardy species, the cimexian, growing one foot high, and flowering in July and September, was introduced from India in 1788.

AZADIRACHTA. See **BEAD-TREE**.

AZALEA. A genus of very beautiful flowering shrubs, of the Rhodora tribe. The species are not very numerous; but the varieties have, of late years, been so exceedingly multiplied and rendered so excessively intricate, as to be almost bewildering. No fancy ornamental shrub, not excepting even the rhododendron, the fuschia, and the camellia, has been more profusely kaleidoscoped by the recent and powerful appliances of scientific culture. In Miller's time, the azalea figured only as two bald species, under the names of white and red Virginian cistus, or white and red American upright honeysuckle; but in the present day, it figures in about one hundred permanent forms, which have been recognised by systematic botany, and in nobody knows how many additional forms of more fugitive character, or within comparatively narrow topical limits. Let an amateur even master a knowledge of the well-defined hybrids which are at present in vogue in the public nurseries or in the most recherche gardens, and he knows not but a dozen new hybrids of as brilliant a character as any of their predecessors may challenge his attention the very next season. The azalea, in fact, is at the present time a fashionable plant;

and, therefore, cannot receive from us any such extended notice as a mere flower-fancier would pronounce it to deserve. The azaleas and rhododendrons are by many writers accounted one genus, under the name azalea. The principal difficulty emanating from their separation is that of determining to which genus the numerous hybrids that have been propagated between the two should be attached.

The clammy species, *Azalea viscosa*, formerly called the white azalea, was introduced to Great Britain from North America in 1734. From its root rise several slender brown stems, to the height of about 4 feet. Its leaves are spear-shaped, narrow at the base, rough in the border, and grow in clusters. Its flowers come out between the leaves, and terminate the branches; they diffuse an agreeable fragrance; they closely resemble in their form the flowers of honeysuckle, each having a tube of nearly an inch in length, divided at the top into five segments, two of which are reflexed; they are white with an exterior of bad yellow in the normal plant, but red in two of the varieties, and variegated in some others; and they bloom in July, but are seldom, in the open ground of British gardens, succeeded by seeds. The principal well-established varieties of this species—of which above one hundred are named—are the scented, the curled, the filleted, the pencilled, the variegated, the cleft, the rubescent, and the pubescent.

The naked flowered species, *Azalea nudiflora*, formerly called the red azalea, was also introduced to Great Britain from North America in 1734. Its stems rise, and its flowers are formed, like those of the preceding species; its leaves are oval, smooth, and entire, and are placed alternately on the branches; and its flowers appear in May and June, are produced in clusters, on long naked footstalks, from the sides of the branches, and are red in the normal plant, but exhibit the various hues of pink, scarlet, blush, and even white in the several varieties. The well-established varieties are no fewer than about fifty in number; and the principal of these have received descriptive Latin names which signify the white, the double-white, the soft, the proliferous, the purple, the sparkling, the thyrses-flowered, the pale-coloured, the flesh-coloured, the party-coloured, the variegated, the butterfly, the corymbose, the Carolina, the semidouble, the red, the ruddy, the roseate, the glomerated, the globose, the small-flowered, the variable, the three-coloured, the violet-coloured, the proliferous, the fastigiated, the florid, the flesh, the scarlet, the mountain, the magnificent, the double-purple, and the wonderful. Very many beautiful hybrid varieties, all different from those now mentioned, were raised a few years ago at Highclere, the seat of the Earl of Caernarvon; and upwards of thirty of these are particularly brilliant, and have been warmly noticed by Loudon both in his *Gardener's Magazine* and his *Hortus Britannicus*.

These hybrids were produced from the *Azalea nudiflora rubescens*, fertilized by the pollen of the variety of *Azalea calendulacea*, called Lee's Triumphant.

The marigold-like species, *Azalea calendulacea*, like the two preceding species, usually grows to the height of about 4 feet. Its principal varieties are about twelve in number, and produce severally yellow, orange, saffron-coloured, or red flowers in May and June.—The Pontic species, *Azalea pontica*, was introduced from Turkey in 1793; and usually grows to the height of about 6 feet. Its principal varieties are about ten in number, and produce yellow, white, and copper-coloured flowers, some in May and June, and others from March till May. The canescent species, *Azalea canescens*, grows to the height of 3 feet, and produces red flowers. The glaucous, the two-coloured, and the hispid species, grow to the height of respectively 2, 4, and 15 feet; and the second produces striped flowers in May and June, while the other two produce white flowers in June. The arborescent and the shining species produce respectively red and white flowers in July; and the former attains a height of 10 or 12 feet. The showy species, *Azalea speciosa*, has been multiplied into a number of varieties, most of which carry red, scarlet, or orange-coloured flowers.

All the preceding species are hardy and deciduous; and, excepting the Pontic, are natives of North America. But the Indian species, *Azalea indica*, is an evergreen and a native of China, and requires in Great Britain the culture of the greenhouse. Six principal varieties of it are in cultivation, the variegated, the double-purple, the orange, the white, the *phoenicea*, and the *ignescens*; and the two last of these have, comparatively speaking, a very imposing appearance.—The Chinese species, *Azalea sinensis*, is also a tender evergreen, and produces yellow flowers.—Another and a more recently introduced species, which has been called *Danielsiana*, is also an evergreen and a native of China, and produces flowers of a carmine colour.

The Indian and the shining species are propagated from cuttings in peat and loam; and all the other species are propagated from layers, or by the dividing of the root. The young shoots, selected for layers, must be slit and laid down, in the same manner as the layers of carnations; and when the layers have struck good root, they may be removed into the nursery, and planted in lines at a small distance from one another, there to stand during at least one year preparatory to final planting. The best season for layering is autumn. After a plant has stood during a few years, it throws up many stems; and some of these may easily be taken off, with a portion of root at each, and planted either in the nursery ground, or in places where they are to remain. All the azaleas love a dry situation, and in fact take their name from a word which signifies dry or arid; and they are most at home in a soil of

peat and loam or sandy peat.—*Hortus Britannicus*.—*Gardener's Magazine*.—*Botanical Register*.—*Miller*.—*Marshall*.—*Maure*.—*The Botanic Garden*.

AZAROLE, — botanically *Cratægus Azarolus*. A tall, ornamental, deciduous shrub, of the hawthorn genus. It is a native of Italy and the south of France, and was introduced to Great Britain in 1640. It usually grows to the height of about 15 feet, and blooms in May and June. Its leaves are large, nearly trifid, serrated, and obtuse; and its flowers are large, and, in the different varieties, are succeeded by fruit of different size, shape, and flavour.—The scarlet-fruited species of hawthorn, *Cratægus coccinea*, is also generally known under the name of Virginian azarole. It is a native of North America, and was introduced to Britain in 1683. It grows to the height of nearly 20 feet; its stem is robust, and covered with a light-coloured bark; its branches ramify and extend in an irregular and rambling manner, and are of a dark brown colour, and armed with a few long, sharp thorns; its leaves are ovate-spear-shaped, smooth, serrated, and of a thick consistence, and often remain on the tree during the greater part of winter; its flowers appear in May, and are individually large, but grow in such small groups as to form rather small umbels; and its fruit is large and of a dark red colour, and ripens late in autumn.—The species of azarole are propagated from seeds; and the varieties, by budding upon stocks of the white thorn.

AZEDARACH. See BEAD-TREE.

AZOTE, or NITROGEN. A gas, the largest constituent of the atmospheric air, and one of the most important elementary substances in the world. It was discovered, as a distinct substance, in 1772, by Dr. Rutherford of Edinburgh, and ascertained to be a constituent of the atmosphere, about 1775, by Lavoisier and Scheele. Its name azote means 'without life,' and was given to it by Lavoisier on account of its total want of adaptation to sustain animal life; and its name nitrogen means 'the generator of nitre,' and was given to it on account of its being an essential element of nitric acid and all nitrate salts. It does not naturally exist in a separate condition, and is usually obtained, in experimental chemistry, by an intricate process of extraction from the oxygen and the other elements of the atmosphere. It cannot, without great difficulty and much elaboration of chemical process, be obtained in a pure condition; and, in consequence, it is liable to be blamed for bad odours and even worse properties, which really belong to partial combinations with it of some other elements. When quite pure, it is the most seemingly negative of all the gases, totally destitute of colour, taste, or smell, quite incapable of acting upon blue vegetable colours, and distinguished from other gases more by negative characters than by any striking or very active property. It cannot support combustion, but extinguishes the flame of all burning bodies which are dipped into it; and

it cannot support animal respiration, but extinguishes the life of all animals which are immersed in it; yet it operates upon both flame and life rather by negation than by action,—rather by the want of intermixed or accompanying oxygen, than by any deleterious or even positive influence of its own. Hence an animal which dies by immersion in it exhibits, upon *post mortem* examination, no traces of injurious action upon either the lungs or the general functionary system. The specific gravity of azote is estimated by Dulong and Berzelius at 0.976, by Dr. Thomson at 0.9722, and by Dr. Turner at 0.9727. A question has, for a considerable number of years, perplexed and partly divided chemists, as to whether azote, though usually classed as a simple substance, is not really a compound; and this question has repeatedly been put to the test of ingenious experiment, and answered in the affirmative, yet must still be regarded as unsolved.

So very seemingly inactive is azote, that, though constituting about four-fifths of the whole atmosphere, it has been supposed by some chemists to serve merely as a diluent or menstruum of oxygen, weakening the strength or softening the energy of that mighty principle of combustion, acidification, and respirational action, and preventing the oxygen from exerting such a stimulating effect upon the animal functions as should speedily wear them to extinction. Even some adepts in organic chemistry, in spite of their meeting it as an abundant element in animal substances, as an essential accessory to vegetation, as an important element in some of the most valuable seeds, as in fact a perfectly characteristic principle of both animal and vegetable nutrition, have been baffled in every attempt to ascertain its mode of action, and induced to regard it as a chemical enigma. M. Le Comte Chaptal, for example, says, "This principle appears to exercise the least influence of all upon substances belonging to either of the three kingdoms of nature. The action of nitrogen is, in fact, so unimportant as far as it is known, that we are at fault to assign any reason why nature should have been so lavish in its diffusion throughout the atmosphere. It has, indeed, been considered by some in the light of a vast aerial magazine, intended to receive all the gases, exhalations, and vapours, which ascend from the earth's surface, and out of which these are again withdrawn, as they may be needed either for the support of animal life, or to quicken vegetation, or for the production of those numerous phenomena of composition and decomposition which are incessantly renovating the surface of the globe." Yet azote is now distinctly known to play a most conspicuous part upon both animal and vegetable organisms, to supply from the atmosphere part of the nourishment of some plants, to supply from plants a main part of the nourishment of all granivorous animals, to evolve from the

decay of animals a chief sustainer of the life of plants, to run a continual circle of connecting agency through non-organic matter, vegetables, and animals, and, in general, to act so prominent and constant a part in the grand reciprocities of the vegetable and the animal worlds as to be the chief of the chemical elements which demand the thorough study of every well-informed cultivator of the soil. Though the mode in which it acts is still, except in a few instances, obscurely known, yet the facts of its acting are exceedingly obvious and far beyond controversy; and these facts give azote its main interest to even a scientific chemist. Its serving as a diluent of oxygen and as a vast storehouse receptacle for this and other gases—or its being a gas at all and so large an element of the atmosphere—are unquestionably circumstances of great value in themselves, and also show how, under the will of the infinitely wise Creator, a grand physical agent, made to serve an ulterior purpose, may at the same time equally serve a subordinate one; yet they must be strictly regarded as mere accessory circumstances, and not confounded with the main designs and uses of the gas. "After oxygen," remarks Liebig, "few substances are of more importance in the economy of nature than nitrogen. Forming so great a part of our atmosphere, it is scarcely possible to conceive that it must not be subservient to other important purposes, besides that of merely diluting oxygen gas. It is dissolved in the water of the sea, of lakes, springs, and rivers. It enters largely into the composition of some vegetables, and of all animals; and it is extremely probable that great phenomena, now obscured, such as the renovation of the air, rain, and perspiration, would be solved by an accurate knowledge of this gas."

Compound chemical elements containing azote are technically said to be nitrogenous, azotated, or azotized; and the chief of these found in animals and plants are gelatine, albumen, gluten, caseum, legumine, urea, osmazome, and fibrin. All plants imbibe or absorb and fix azote; yet, when viewed in the aggregate, they contain so very small a proportion of it compared to their other elements, that, till a few years ago, it was, in many instances, unobserved or unheeded in their analysis. Animals, on the other hand, possess so large a proportion of it in their blood, in their juices, in their organisms, and generally throughout their system, that its presence is the cause of many of their most characteristic chemical features. All the higher orders of animals receive their nourishment directly or indirectly from vegetables; they obtain the characteristics of that nourishment, or the constituents of blood, in the form of nitrogenous elements; for each pound of nitrogen which they require in order to the sustenance of life and the maintenance of health, they must consume as much vegetable matter in the form of food as contains a pound of nitrogen; and as both the proportion of nitro-

gen in each healthy animal and the quantity of it in each edible vegetable is fixed or uniform, an exact correlation exists between the nourishment of any animal, and the nitrogenous contents of each kind of vegetable aliment. Yet as both animals and vegetables are composed of several proximate principles or compound elements, and as these principles exceedingly differ from one another in their nitrogenous character, some, as the fat of animals and the woody fibre of plants, being wholly destitute of nitrogen, while others, as albumen and gluten, contain it in great quantities, so animals may increase in nitrogenous elements to the neglect of non-nitrogenous ones, or may increase in non-nitrogenous elements to the neglect of nitrogenous ones, according to the nature of their food. Fatty matter, for example, requires for its formation an excess of hydrogen, but neither contains nor requires any nitrogen; while muscle requires no excess of hydrogen, but consists almost wholly of the nitrogenous elements, albumen, fibrin, and osmazome, and, in consequence, requires a high excess of nitrogen. If, therefore, cattle are fed upon substances which contain a small proportion of nitrogen and an excess of hydrogen, such as oil cake, they speedily become fat, without acquiring a proportional increase of beef or muscle; and if, on the contrary, they are fed on substances which are rich in nitrogen, such as the seeds of leguminous plants and of the cereal grasses,—especially when they, at the same time, enjoy the powerful excitant to the increase of muscle which is afforded by steady and habitual muscular exertion,—they speedily become fuller and rounder in their masses of muscular tissue, without acquiring any proportional increase of fat. An obvious inference is, that to feed an animal with the view of fattening him, and to feed him with the view of strengthening him, are totally different processes, and require totally different aliments; and another inference, though not so obvious an one, is, that neither of these processes can be much or long continued to the exclusion of the other, without causing very serious damage to the constitution.

As the proportion of azote is always greater in animals than in vegetables, so the more of azote any vegetable contains, the less of that vegetable is required for the nourishment of any animal; and the less of azote another vegetable contains, the more of this vegetable is required for the animal's nourishment. This principle is of the highest moment in all the economics of a farm, and indeed of human life and the world's affairs; and it has been worked out and vindicated by an energy and a bulk of experimental proof which must force conviction on even the dullest thinker. A number of experiments were instituted, a few years ago, by various individuals on the continent, with the view of ascertaining the nutritive powers of various kinds of food, and were performed both with mechanical care as to the quantities of the food employed, and with chemical

skill as to the known or ascertained constituent elements. "Cattle and horses were fed upon weighed quantities of different kinds of food, and the effect produced upon them accurately observed, both as regarded increase of weight, health, and vigour; and as the results of these experiments, a table of the relative nutritive powers of different articles of food was drawn up, each article having an equivalent assigned to it,—100 lbs. of meadow hay being taken as the standard of comparison. From a careful perusal of these tables, M. Boussingault was led to the conclusion, that the difference in the value of the various articles of food corresponded with the difference in the proportion of their azote. He therefore analyzed with great accuracy a considerable number of vegetables, and arranged them in a table, in which the equivalents assigned to each plant designated the exact quantity of azote which it contained as compared to 100 lbs. of meadow hay, the equivalent, of course, increasing as the proportion of azote diminished. Now, on comparing these two tables, the most astonishing concordance is observed; indeed, when it is considered that M. Boussingault's results must, of necessity, be absolute, whereas the practical equivalents may be rendered uncertain by many fortuitous circumstances, as the health of the particular animal employed, &c., the coincidences which occur are truly surprising. For example, concerning one of the least nutritious kinds of food, the turnip, M. Boussingault considers 612 as its equivalent, and M. Thaër, who examined it practically, fixes it at 611. This table, which is full of interest, is published in the 63d volume of the 'Annales de Chimie et de Physique.' Surely such experiments as these must prove to demonstration that, *ceteris paribus*, that food is most nutritious which contains the greatest quantity of azote, and, *vice versa*, that a deficiency of azote in any article of food will indicate a corresponding deficiency in its power of supplying nourishment." [Dr. Madden in *Quarterly Journal of Agriculture*.]

Every plant, during its life, fixes azote; and appears to obtain some of it from the atmosphere, most of it from manures, and probably all of it in the form of ammonia and nitric acid. All the organs of a plant, without exception, commence their formation with a nitrogenous matter analogous to fibrin; and they ever afterwards have this matter in association, not only with the amy-laceous secretions, but even with the cellular and the ligneous tissues. The nitrogen fixed by every nascent or rudimental plant produces a concrete fibrinous substance, which constitutes the rudiment of all the vegetable organs; and this substance is never afterwards destroyed, but is always to be found, no matter in how minute an aggregate quantity, or how excessively or almost atomically divided by the interposition of enormous proportions of non-nitrogenous matter among its particles. Nor does this substance

merely serve as the germ and the delineator of the several organs; but it also produces the liquid albumen which the coaguble juices contain, and the caseum which is so often confounded with albumen, but whose separate existence in many plants can be easily recognised. The fibrin, the albumen, and the caseum of plants are their grand nitrogenous elements; they have a closely similar composition to one another; and they present a striking parallel or counterpart to respectively the ligneous matter, the amidine and the dextrine. For fibrin, like the ligneous matter, is insoluble,—albumen, like amidine or starch, coagulates by heat,—and caseum, like dextrine, is soluble; these nitrogenous elements, as well as the three parallel non-nitrogenous elements, are neutral; and they act the same part by their abundance in the animal kingdom, which the ligneous matter, the amidine, and the dextrine, act by their abundance in the vegetable kingdom. "Besides," says M. Dumas, "in like manner as it suffices for the formation of non-azotated neutral matters, to unite carbon with water or with its elements, so, also, for the formation of these azotated neutral matters, fibrin, albumen, and caseum, it suffices to unite carbon and ammonium with the elements of water; forty-eight molecules of carbon, six of ammonium, and seventeen of water, constitute, or may constitute, fibrin, albumen, and caseum. Thus, in both cases, reduced bodies, carbon or ammonium and water, suffice for the formation of these matters; and their production enters quite naturally into the circle of reactions, which vegetable nature seems especially adapted to produce." The great facts, then, that fibrin, which serves as the rudiment of all the organs of plants, is a nitrogenous element,—that albumen and caseum, which are so largely diffused in all the most nutritious plants, and which are assimilated or modified by animals according to the exigencies of their nature, are nitrogenous elements,—that these three chief proximate elements of bulk in animals, which correspond to the three chief proximate elements of bulk in vegetables, are nitrogenous elements,—these facts powerfully evince that the function of nitrogen in plants, and the part which it plays in the reciprocities of elements upon a farm, are worthy of very serious study.

A considerable part of the azote fixed by plants appears to be obtained, if not from atmospheric air, at least from gaseous matter held in mechanical mixture with the atmosphere. M. Boussingault instituted experiments, to ascertain whether developed plants, endowed with perfect organization, obtain azote, when they are cultivated in a soil absolutely deprived of organic matter; and he found that clover grown in sand, which had previously been calcined to a red heat, receives into its organization a certain quantity of azote, and that pease grown under a similar regimen, and having for their whole food

nothing but water and air, flowered and produced seeds to perfect maturity. From these facts, and some others, he infers that, "in many conditions, certain plants are apt to draw from the azote in the air;" and he adds, "but in what circumstances and in what state azote fixes itself in vegetables, is as yet unknown to us. Indeed, azote can enter directly into plants, if their green parts are fit to fix it. Azote, too, can be conveyed into vegetables by water, which is always aerated, and which is always taken up by the roots. In short, it is possible, as many physicians think, that it exists in the air in very small quantities of ammoniacal vapour." M. Boussingault is thus as vacillating and doubtful as to the form in which the azote enters plants, as he is certain respecting the fact of their obtaining it from the atmosphere; and while he commences his very brief statement on the subject by seeming to assert that they extract it from atmospheric air, he terminates with the suggestion that they possibly receive it under the form of ammoniacal gas. Yet no evidence whatever exists that plants can assimilate nitrogen from atmospheric air, while very satisfactory evidence has been exhibited by Liebig, and tested by other eminent chemists, that they very readily obtain it from ammoniacal gas in the atmosphere, not alone by the suffusion of that gas around them, but also and chiefly by its descent to their leaves and roots in a state of solution in rain-water. Whoever peruses our article on AMMONIA, and assents to the doctrines which it advocates, will have scarcely a doubt that most, and very probably all, of the nitrogen fixed by the clover and the pease in M. Boussingault's experiments, was obtained from ammonia held in commixture with the atmosphere.

Dr. Liebig, indeed, assumes such high ground as to assert that all the nitrogen of plants, in all circumstances whatever, is obtained in the form of ammonia,—that, when brought into contact with them in the soil in any other form, it combines with hydrogen to constitute ammonia before being available to them,—and that in the case of fertilizing by the use of nitrates, a doubt is due whether the fertilizing power may not re-

side in the base of the salt rather than in the nitrogen of its nitric acid; and, in reference to plants obtaining nitrogen from the atmosphere, he says, "Plants, as we know, grow perfectly well in a mixture of charcoal and earth, previously calcined, if supplied at the same time with rain-water. Rain-water can contain nitrogen only in three forms, as dissolved atmospheric air, as nitric acid, or as ammonia. Now, the nitrogen of the air cannot be made to enter into combination with any element except oxygen, even by the employment of the most powerful chemical means. We have not the slightest reason for believing that the nitrogen of the atmosphere takes part in the process of assimilation of plants and animals; on the contrary, we know that many plants emit the nitrogen which is absorbed by their roots, either in the gaseous form, or in solution in water. But there are, on the other hand, numerous facts, showing that the formation in plants of substances containing nitrogen, such as gluten, takes place in proportion to the quantity of this element conveyed to their roots in the state of ammonia, derived from the putrefaction of animal matter." The conclusion which Dr. Liebig afterwards attempts to found upon other premises, that plants receive the whole of their nitrogen in the form of ammonia, appears to us, and has appeared to far abler judges, to be hasty and ill-reasoned; yet no reasonable doubt can exist that most or all plants receive their chief supply of nitrogen in the ammoniacal form. This, for all the practical purposes of agriculture or of gardening, is the whole drift of the question of nitrogen,—the grand and momentous fact which challenges the cultivator's attention; and with this fact before them, our readers will do well to give a very careful perusal to our article on AMMONIA.—*Turner's Elements of Chemistry.*—*Ure's Dictionary of Chemistry.*—*Thomson's System of Chemistry.*—*Davy's Agricultural Chemistry.*—*Liebig's Chemistry of Agriculture.*—*Boussingault's Rural Economy.*—*Chaptal's Chemistry applied to Agriculture.*—*Johnston's Lectures on Agricultural Chemistry.*—*M. Dumas in the Philosophical Magazine.*—*Dr. Madden in Quarterly Journal of Agriculture.*—*Edinburgh New Phil. Journal.*

B

BABIANA. A genus of ornamental, bulbous-rooted plants, of the iris tribe. Nearly twenty species, all natives of the Cape of Good Hope, have been introduced to Great Britain. They grow to the height of from 6 to 12 inches; produce blue, purple, puce, red, and variegated flowers; present a near resemblance to the *ixias* and the *gladioli*; require greenhouse culture; and are propagated from offsets. They agree best with sandy peat. Their name is of Dutch origin, and refers to the circumstance of their bulbs being greedily eaten by baboons.

BACCHARIS,—popularly *Ploughman's Spike-nard*. A genus of ornamental undershrubs, of the composite tribe. Upwards of one hundred species have been scientifically described; but only about a dozen of these have been introduced to Britain. Two of the introduced species, the cluster-flowered and the halimus-leaved, are deciduous and hardy; and all the others are evergreen, and more or less tender. The two species long and best known, are the Iva-leaved and the halimus-leaved; they have, for nearly two centuries, been grown in the gardens of the curious; and they were extensively known, in Miller's time, under the names of the African tree-groundsels, and the Virginian groundsels.

BACCIFEROUS PLANTS. Any trees, shrubs, or other plants which produce berries. When any fruit is round, principally soft, containing seeds in a pulpy substance, it is called *bacca* or a berry; and when it is principally of firm consistence, and contains its seeds in a fleshy substance, it is called a pomum, pome, or apple. The fruit of the strawberry plant, though universally and irretrievably called a berry, and though very closely resembling one in appearance, is really a receptacle, or organ of the same kind as the sole or base of any composite flower, and does not contain its seeds within a pulp and covering, but exhibits them on the exterior of a fleshy nodule. Familiar examples of bacciferous plants are currant bushes, briony, lily of the valley, Solomon's seal, asparagus, nightshade, and butcher's broom.

BACK. The spine of an animal. The back of a horse consists of a chain of 18 bones, called the dorsal vertebræ. This part of the animal bears all the weight of burden, and has been so wonderfully constructed by the Creator as to combine the greatest degree of strength with ease of locomotion. In order to prevent violent jolting, and to assist in turning, the back consists of a chain or series of bones with interpositions of highly elastic cartilage; and in order to occasion the highest degree of strength, the bones

are inserted into one another somewhat in the manner of a rick of cups, the interposed cartilage is more resistive of fracture than even the bones, and a series of powerful ligaments runs along the broad lower surface of the bones, lengthening and contracting in the same manner as the great ligament of the neck. A long-backed horse has speedy motion and easy paces, but is comparatively weak, and cannot bear a heavy burden; and a short-backed horse is strong and enduring, but wants both speed and ease of motion. An overworked or ill-used horse sometimes suffers ossification in the ligaments of the spine, and becomes *broken-backed*. A strong and beautiful horse, possessing the most desirable form of back, has a little depression behind the withers, and is nearly straight-lined thence to the loins; a *saddle-backed* horse has a comparatively deep depression behind the withers, as if a hollow existed for the saddle, and he has easy paces, but wants strength and is apt to sprain; and a *roach backed* horse has a slightly arched spine, somewhat like the curvature in the back of a roach, and he is, in consequence, sadly deficient in at once beauty, strength, and practical adaptations.

BACKING. The backward motion of a draught-horse, by command of his driver. To teach a horse to practise this motion with promptitude and steadiness, is an important part of his training.—But backing also means the restive or vicious backward motion of a horse, in circumstances where he ought to move forward. Some horses practise this trick only at starting, and others practise it on almost any sort of occasion; some acquire it by some act or process of bad breaking, such as painful adjustment of the collar, pulling up hill, or sudden starting, and some appear to practise it from laziness, caprice, or bad temper; some may readily be cured of it by adroit management, gentle whipping, or the placing of strong obstacles in the way of backing, and others can scarcely or but temporarily be cured by such strong remedies as assigning them the middle place of an agricultural team of three or the near-wheeled place of a stage-coach yoke of four, where they will be dragged along by their companions till they find a forward draught much easier than a backing resistance. Backing, in this second sense, is also called *gibbing*.—But backing, in a third sense, means, the breaking or first mounting of a colt, or teaching him to receive and endure a rider. No person ought to attempt this who has not a considerable knowledge of the disposition and tricks of young

horses, and some experimental acquaintance with the methods of controlling them.

BACK-SINEWS. The strong tendons in a horse, which extend along the hinder part of the shank from the knee to the heel. They are confined to their situation and defended from injury, by an enclosing sheath of dense cellular substance; and they are kept in a lubricated condition, and protected from injurious friction, by the interposition of a mucous fluid between them and the sheath. A peculiar hurt, technically but improperly called a sprain of the back-sinews, is one of the most frequent accidents which occur to a horse, and is often very troublesome, and sometimes followed by very prolonged bad consequences. When a horse is overworked, or overladen, or violently exerted, or ridden hard upon dry ground, or makes a bad false step, or has the heels of his shoes too much lowered, a rupture is made in some of the fibres which confine the tendons, or inflammation is excited in the delicate membrane-lining of the sheath; a coagulating liquid is exuded, adhesion is effected between the tendons and the sheath, and the motion of the limb becomes difficult and painful. When these injuries occur, or *the sprain*, as they are called, has been produced, swelling is easily observable in the sinews, and sometimes extends over their whole length from the knee to the heel, and the horse does not care to set his hurt foot even on the ground, but, when standing, usually sets it before the uninjured foot. Cold charges, often renewed, frequently cure this malady. Currier's shavings bound round the knee with a bandage, have sometimes been employed with success. Vinegar or verjuice mixed with bole, soaked warm into the sinews many times in a day, has been still oftener and more signally successful. Even fomentations with warm water, every half hour, and intermediate poulticings with linseed meal, are eminently efficacious. But when any risk exists of the local inflammation producing general disturbance of the system, the animal should be bled at the toe and physicked. When any lameness or swelling remains after the reduction of the inflammation, and the fair use of topical washes, fomentations, and poultices, a mild blister, free from all corrosive matter except such as is requisite to effect the blistering irritation, will, in general, effect a cure. Hot and relaxing oils, though recommended by many practitioners, ought by no means to be used; for they are apt to engender bad wind-galls, to make the veins on each side of the sinews full and gorged, to aggravate all the evils which they are designed to assuage, and even, in some instances, to induce a lameness of two or three years' duration. A very severe sprain, or a sprain which has been confirmed and aggravated by bad treatment, may require the application of the cautery. "Blistering in this case," says Gibson, "has very little or no effect; firing through the vein till the blood comes be-

ing only sufficient. After the firing, the whole leg, from the knee down to the heel, and all the hollow places on both sides, must be charged with a good strengthening plaster, which will perfect the cure, especially if the horse be turned to grass for a month or five weeks, or, in the winter, if he run a little while in a smooth yard, where he has good dry litter." Any person who examines a horse with the view of purchasing him, ought to observe narrowly whether there be any thickness in the cellular substance around the back sinews; for if there be, the horse has almost certainly suffered a severe sprain, and will probably become lame and unsound within a day or two of being put to ordinary hard work. —*Gibson on the Diseases of Horses.*—*Youatt on the Horse.*—*Clater's Every Man his own Farrier.*

BACON. The salted and dried carcass of the hog. But the salted and dried hams are usually regarded as a distinct commercial article from bacon; only dried and smoked flitches are frequently regarded as bacon; salted and half dried, but ill-smoked flitches are called sometimes bacon and sometimes green bacon; and salted but undried flitches are called sometimes green bacon and sometimes salt pork. All parts and conditions of the salted carcass of the hog, however, must, for the sake of a correct and comprehensive view of the subject, be treated by us as bacon; and, in this large sense, they include on the one hand a bulky, important, and very common aliment of the agricultural poor, and, on the other hand, a highly esteemed and very general luxury of the middle and upper classes of both town and country.

The fat of the hog differs from that of other quadrupeds and of man, at once in quality, in consistency, and in mode of distribution over the body. "The fat of man, and of those animals which have no suet, as the dog and the horse," remarks Buffon, "are pretty equally mixed with the flesh; and the suet of the sheep, the goat, and the deer, is found only at its extremities; but the fat of the hog covers the animal all over, and forms a thick, distinct, and continued layer between the flesh and the skin." Well-fed, properly killed, and judiciously salted bacon, whether dried or undried, is a pleasant, valuable, and comparatively cheap provision for the peasantry in many parts of Great Britain; and even miserably fed and abominably prepared bacon, in its crudest salted condition, serves many tens of thousands of the Irish population in lieu of all other animal food, and performs, in their case, the requisite function of a mixture of animal aliment with vegetable matter in maintaining health in the human constitution. But the luxurious forms of smoked ham used in cities by the middle classes and the rich, are far more a condiment than an aliment, and often act deleteriously upon health. The best bacon usually sold in London is the ill-cured flesh of rapidly fattened hogs, and, though not a bad food of its kind, is

always too salt to be perfectly wholesome. The use of even this best sort, and especially of inferior sorts, as a corrector of bile and a strengthener of the stomach at breakfast, is a gross and puerile delusion. Though a perfectly suitable breakfast meal for all persons with whom it agrees, yet, in many constitutions, it seldom fails to develop sebaceous acid and to produce decided acetous fermentation. All thoroughly dried bacon is more trying to the gastric power than such as is 'green' or but partially dried; and a fried portion of any one ham or fitch—a portion used in the prevailing 'rasher' fashion of bacon consumption in towns—is also more trying than a portion which is boiled. But, above all, the diseased and nauseous dried flesh which is hurriedly manufactured out of Irish pigs, and sold in the markets of England under the name of Irish bacon, and often under the names also of Lancashire bacon, Somersetshire bacon, and Yorkshire hams, is both disagreeable to the stomach, and injurious to the health. A drove of ill-fed and hastily fattened swine are landed, half sea-sick, at Liverpool or Bristol from an Irish steam-packet; they are speedily driven across the country, to the certainty of their being fevered or otherwise much injured in health; and, without being subjected to any restorative regimen, but while they continue half prostrate with exhaustion and disease, they are slaughtered, and, with the profuse aid of salt, converted into bacon and hams. Their flesh, of course, is soft, flabby, disgusting, and unwholesome, and cannot, by any excess or prodigality of salting, be purified from its abominations. Real Irish bacon, indeed, or such as is cured in Ireland, particularly in Belfast and Newry, for exportation to England, is generally good in quality, sound, healthy, and tolerably well prepared; and the bacon of the best British districts for the supply of the general market—particularly the bacon of Hampshire, Berkshire, Wiltshire, Yorkshire, Dumfriesshire, Kircudbrightshire, and Wigtonshire—is, for the most part, eminently good; yet, as a general rule, all bacon which is intended for the general market, or which is cured in any circumstances with a view to pecuniary return, is both worse fed and worse prepared than such as is intended for consumption on the spot. The very best bacon in England is cured in Buckinghamshire, Gloucestershire, Suffolk, and part of Hampshire; yet, except in the form of presents, scarcely an ounce from these districts ever reaches the markets of London.

One great requisite for obtaining prime bacon is, that the hog be of an improved breed; but this we defer for consideration to our article on the Hog. Another and still greater requisite is that the hog be properly fed and fattened, either in a clean sty or upon clean ground, so that the flesh and the lard shall be of firm texture and agreeable flavour. In Buckinghamshire, where hog's flesh is the only animal food used by the

agricultural classes, and where the local bacon is equal in every excellence to the best in any other part of Great Britain—in Gloucestershire also, especially in the royal forest of Dean, where swine's flesh is the chief food, and where the forester identifies his wealth with a pair of fat hogs in his sty and a pair of fitches of bacon in his house—the swine feed heartily on beech mast, acorns, and the other edible productions of the woodlands. But we must reserve this topic also for the article on the Hog, and direct our present attention to the third great requisite, the manner of preparing the bacon. Yet we must be understood, not as interfering with the regular ham-curer, or with any party who trades in pork or bacon which he does not rear, but simply as affording information to farmers and other hog feeders, who kill their swine either for domestic consumption or as part of the profits of a farm.

In order to clear the stomach of food and the intestines of feces, and to prepare them for being properly divested of all the mudgen lard, the animal should be kept from eating during at least twelve hours previous to its being killed. The proper method of slaughtering is so universally known, that it needs not be described; and, indeed, is more properly the work of the village butcher than of any cottier or agricultural operative. The usual manner of removing the hair and producing cleanness and smoothness of the skin, is to lay the dead animal upon a table or broad board, to scald it piece by piece with boiling water from a tea-kettle or other vessel, and to scrape or shave each scalded piece with a large sharp-edged knife. In most farm-houses, pork intended for home use is merely well salted, cut to pieces, deposited in kits, covered with a very strong and well purified brine, and kept in that situation from a few weeks to two or even three years. The brine should be made sufficiently strong to float an egg, and simmered over a gentle fire till its impurities rise to the surface and be skimmed off, and ought not to be poured upon the pork till quite cold; and if the bacon lie in the brine upwards of two years before being used, it is superior in flavour, firmer in its fat, and more resistive of waste when boiled, than if kept for a shorter period. But the general method of proper killing and preparing for the market is described as follows by Henderson:—"After the carcass has hung all night, lay it upon a strong table or bench upon its back, cut off the head close by the ears, and cut the hinder feet so far below the hough as not to disfigure the hams, and have plenty of room to hang them by. Then take a cleaving knife, and, if you choose, a hand mallet, and divide the carcass up the middle of the backbone, laying it in two equal halves. Then cut the ham from the side by the second joint of the backbone, which will appear on dividing the carcass; then dress the ham by paring a little off the flank or skinny

part, so as to shape it with a half round point, clearing off any top fat that may appear. Next take off the sharp edge along the backbone with the knife and mallet, and slice off the first rib next the shoulder, where he will perceive a bloody vein, which you must take out, for if it is left in, that part is apt to spoil. The corners must be squared off where the ham was cut out. In killing a number of swine, what sides you may have dressed the first day lay upon some flags or boards, piling them up across each other, and giving each fitch a powdering of saltpetre, as it opens the pores of the flesh to receive the salt, and besides gives the ham a pleasant flavour, and makes it more juicy. Let them lie in this state about a week, then turn those on the top undermost, giving them a fresh salting. After lying two or three weeks longer, they may be hung up to dry in some chimney or smokehouse. Or, if the curer chooses, he may turn them over again, without giving them any more salt; in which state they may lie for a month or two without catching any harm, until he has convenience for drying them." But the flitches, while being salted, should be laid with the rind underneath, and placed in such a position, either upon a guttered tray or an inclined plane, as to allow the brine to run from them. A smokehouse is, in general, a mere hut, about seven feet high, and so closed on all sides as to cause all the smoke to ascend by a small hole in the roof; the fuel is saw-dust spread to the depth of five or six inches over the whole of the floor; the fire is a slow, smouldering, and inflaming combustion, equally supported throughout day and night; the flitches and hams are well rubbed with bran, and suspended from the roof or from cross-bars at such a height as to reach within $2\frac{1}{2}$ or 3 feet of the floor; flitches are hung with the neck downward, and are usually well enough, and without much loss of weight, dried and smoked in a fortnight; and the hams, if thoroughly prepared to combine luxury with nutriment, require to be smoked for a considerably longer period, and lose one-seventh or one-sixth of their weight. A very small smokehouse will serve for a large number of hogs, and can be both constructed and maintained for a trifling expense. But whenever wood fuel is used in the farmhouse or the cottage, the drying and smoking are usually effected by suspension in the chimney; and the use of oaken billets and oaken brushwood, in particular, is said to impart a very superior flavour.

The bacon and hams of Buckinghamshire, which have the reputation of being the best in Great Britain, are prepared according to a different method from Henderson's. The carcass, instead of being scalded and shaven, is divested of its hair by singeing with straw and scraping. The head, the tongue, the chine, and the shoulders, are salted in the ordinary manner of salting meat; and the flitches and the hams are placed respectively apart for separate treatment.

Two ounces of finely pulverized saltpetre are well rubbed over each fitch, especial care being used to apply a larger quantity to the parts whence the ham and the shoulder have been removed; the flitches are then placed, during ten or twelve hours, upon the salting form; a mixture of seven pounds of salt and a pound and a quarter of coarse moist sugar, is heated in a frying-pan, and so stirred as to attain an uniform temperature; the flitches are rubbed all over with this mixture in as hot a state as the hand can possibly bear it; they are then placed, the one upon the other, in a salting-pan, when the brine immediately begins to form; they are well basted and rubbed with the brine and turned twice a-week, the under fitch being placed uppermost at every turning; and at the end of four weeks, they are hung up to dry, and afterwards smoked. The two hams are cured simultaneously with the flitches. Each ham, like each fitch, is well rubbed with two ounces of finely pulverized saltpetre; it is then placed, during ten or twelve hours, in a separate dish, with the rind or back part downward; it is next rubbed with a hot mixture of salt and sugar, in the same manner as the flitches, with the simple difference that only four pounds of salt are mixed with the $1\frac{1}{4}$ pound of sugar for the hams; it is then put into a salting-pan to make its own brine; it is rubbed and basted with the brine and turned every day during five weeks; and is then hung up to dry, and is afterwards smoked. The two brines may now be mixed with each other, and with half a pound of moist sugar, and may be boiled, skimmed, and cooled, as a preparing brine for a further luxury. A number of neats' tongues, salted during twenty-four hours to make them disgorge, and a number of sheep's, hogs', and deer's tongues, previously put in salt for a few hours, may be immersed and digested in this general brine for three weeks, preparatory to their being either immediately taken to the table, or to their being dried and smoked. The flitches and the hams are suspended on nails or on a bacon-rack in the ceiling of the kitchen, till they are externally quite dry, and have their remaining pickle crystallized upon their surface; and they are then hung in the chimney to undergo the action of the smoke from the wood fires. A considerable degree of the peculiar excellency of Buckinghamshire bacon is thus dependent on the method of curing; but much also arises from the domestic use of wooden fuel, and still more from feeding in the woodlands, and from cleanliness, nicety, and attentiveness of management.

In Hampshire, the method of curing is very similar to that in Buckinghamshire, with this difference, that, for the flitches, four pounds of white and two pounds of bay salt are mixed with two pounds of coarse brown sugar and four ounces of sal prunella, and, for the hams, two pounds of white and one pound of bay salt are mixed with two pounds of brown sugar and three ounces of

sal prunella. Along the coast and in the islands of this county, both the flitches and the hams are smoked with dried sea-weed, and, in consequence, acquire a rich and delicious flavour.—In Suffolk, the quality of pork is much inferior to that of the forest-fed swine of Buckinghamshire and Gloucestershire, and yet the quality of bacon is so improved by the mode of curing as to be little if at all inferior. The hot pickle for the flitches consists of three pounds of white and two of bay salt, six ounces of sal prunella, and four pounds of coarse brown sugar; and that for the hams consists of two pounds of white and one pound of bay salt, three pounds of coarse brown sugar, four ounces of saltpetre, two ounces of sal prunella, a few grains of whole black pepper, a few grains of whole Jamaica pepper, and a quart of very stale strong ale,—the whole purified by heat and skimming, boiled till nearly dry, and rubbed into the hams in as hot a state as the hand can possibly bear. Both flitches and hams are prepared for the pickle by salting and twenty-four hours' disgorgement, and are wiped very dry before the pickle is applied; the flitches are rubbed, basted, and turned three times a-week for four weeks; the hams are basted and turned every day during five weeks; and both are eventually smoked either in chimneys where wood fuel is consumed, or elsewhere with leaves, brush-wood, and branches of trees mixed with litter.—In Yorkshire, the curing is similar to that in Buckinghamshire, but with less salt and more sugar; and the smoking is effected in smoke-houses, with wood, shavings, and a few aromatic herbs, the fire being made to smoulder and yield a profusion of smoke by means of wet straw placed on the top.

In Somersetshire, the flitches are disgorged under salt for twenty-four hours in wooden troughs; they are then wiped dry, and the troughs well washed and wiped; they are next replaced in the troughs, and are rubbed once a-day for four days, with as much hot bay salt as they will absorb,—the salt being heated in a frying-pan, and applied in as hot a condition as the hand can bear,—and the flitches being turned only every second day; they then remain in their brine from 16 to 21 days according to their size, and are turned on every second day of this period; and they are finally hung up to dry, but are not smoked.—In Gloucestershire, the bacon possesses so extraordinary excellence from superior feeding that, were it prepared in the Buckinghamshire or Suffolk manner, it would be surpassingly delicious; but it is cured in nearly the same method as that of Somersetshire, with the simple difference of preparing each flitch for its first dose of hot salt, by rubbing it with four ounces of saltpetre, and allowing it to lie three or four hours till the saltpetre is absorbed.—In Westmoreland, each ham is hard rubbed with bay salt, and left on a stone bench to drain off its brine; after four or five days, it is again rubbed

with bay salt mixed with about an ounce of finely pulverized saltpetre: and about a week after this second rubbing, it is hung up in the chimney, either so as to be dried by the heat without exposure to the smoke, or so as to receive the full fannigation of all the smoke which arises from either wood or peat.—In the bacon counties of Scotland, the general method of curing is Henderson's, modified by circumstances and localities, and very extensively substituting the use of the chimney as in Westmoreland for that of the smokehouse.—A somewhat general practice of late years has been to doctor recent salted pork with chemical preparations of pyroligneous acid, creosote, and other abominations, applied with the brush, so as to save the labour of thorough curing and of smoking, and to make the pork pass for well cured and well smoked bacon and ham; but the result is both offensive to a nice palate and decidedly hurtful to the stomach; and the practice, altogether, classes rather with the adulterations of food than with its preparations.

The method of curing and smoking the celebrated Westphalian hams might seem to promise the best model for preparing prime bacon; but that method does not very widely differ from the Suffolk method; and all the really superior Westphalian hams owe their principal excellence to their being the flesh, not of the domestic hog, but of the wild boar and the stag. A method practised and published by a writer in the fourth volume of the Magazine of Domestic Economy, appears to combine all the good points of both the Westphalian method and the best English methods, and though quite too refined in its superadded appliances for producing a superior flavour, is well worthy of attention. "The moment the hams are cut from the hog," says this writer, "they are to be rubbed with common salt, then placed upon a flat board with another over them; and two half-hundred weights placed upon the upper board over each ham. Under this pressure they must remain 24 hours. They are to be then taken up and wiped ready for the pickle, which must be thus prepared in readiness. A pound of bay salt and one of common salt, two pounds of moist sugar, four ounces of saltpetre, two ounces of sal prunella, a quarter of a pound of juniper berries bruised in a mortar, three bay leaves, a sprig of thyme, one of sweet basil, one of marjoram, one of sweet brier if it is to be had, and one of tarragon, also a few peppercorns and grains of allspice, are put into a saucepan with a quart of the strongest and stalest ale. The whole is boiled together, keeping the saucepan covered for about twenty minutes. When sufficiently cool for the hand to bear it, but being still of a high temperature, the herbs are thrown into the pickling-pan, the hams placed immediately upon them, and the whole of the hot pickle well rubbed into the hams. The brine is soon formed, and the hams are to be turned in it and basted with it every day during a month,

when they must be taken out, dried and smoked in the following manner. Being hung in a large chimney without a grate, a layer of dry straw is put down, upon this a layer of mixed shavings, next a layer of mixed sawdust, with a good handful of juniper berries, and over the whole a mantle of wet straw or litter, which makes the fire smoulder and emit much smoke without burning rapidly. The dry straw is now lighted, being lifted up a little so that it may well ignite, and also catch the shavings and sawdust. This smoking must be repeated several times until the hams are quite dry, when they must be placed in the warm kitchen upon shelves near the fireplace, and turned twice a-week. To cure bacon by the same process, the only difference is that a pound each of common and bay salt are added, and the sugar reduced to a pound and a-half. All the rest of the process is the same."

—Henderson on Swine and Bacon.—The Magazine of Domestic Economy.—The Board of Agriculture's Reports of Counties.—Marshall's Gloucestershire.—Doyle's Practical Husbandry.—The Knowledge Society's British Husbandry.—Hunter's Geographical Essays.—MacCulloch's Commercial Dictionary.

BADGER. A genus of plantigrade animals, included by Linnæus among the bears; but now forming the distinct genus *Meles*. The common badger, *Meles vulgaris*, is about the size of an ordinary dog; but stands considerably lower on its legs, which are so short that its belly seems to touch the ground; this, however, is caused by the length of the hair, which is very long all over the body, and makes it seem much more bulky than it really is. The throat, breast, and belly, are covered with black hairs; those of the upper part of the body are yellow-white at the bottom, black in the middle, and ashy gray at the point. It is a solitary animal, that finds refuge remote from man, and digs itself a deep hole with great assiduity. It seems to avoid the light, and seldom quits its retreat by day, only stealing out at night to find subsistence. It burrows in the ground very easily, its legs being short and strong, and its claws stiff and horny. As it continues to bury itself, it throws the earth behind it to a great distance, and thus forms to itself a winding hole, at the bottom of which it remains in safety. As the fox is not so expert at digging into the earth, it often takes possession of that which has been quitted by the badger; and, some say, forces it from its retreat, by laying its excrements at the mouth of the badger's hole. This animal, however, is not long in making itself a new habitation, from which it seldom ventures far. When surprised by dogs, at some distance from its hole, it combats with desperate resolution; falls upon its back, defends itself on every side, and seldom dies unrevenged in the midst of its enemies. The badger's principal food is roots, fruits, snails, and worms. It sleeps the greater part of its time, and thus, without being a voracious feeder, it still keeps fat, particu-

larly in winter. Beneath the anus, there is an aperture, opening transversely, which exudes an oleaginous matter of an extremely fetid odour.

The spotted badger is of a white colour, marked with reddish, yellow, and dusky spots. It inhabits Europe and the north of Asia, as far as the northern provinces of Persia and China, and in Japan. The white badger is said by Mr. Brisson to have been brought from New York; it has very small eyes, and very short legs, and is only one foot nine inches long, with a tail of nine inches. The American badger—the *sigileur* of the Canadians—inhabits Labrador, and the country about Hudson's Bay, in North America. This animal has a strong resemblance to the common or European badgers, but is somewhat smaller, and the hair is longer, more soft and silky; the ears are short, and of a white colour, edged with black; the head is white, with a black line on each side running from the forehead close to the inner corner of the eye, down to the nose; the hair on the back is four or five inches long, bright brown for the under half, then bright yellow, above that black, and white at the tips; the legs are short, and of a dark brown colour; having five claws behind, and only four before, which are considerably longer and larger; but the want of the fifth claw on the forepart being described from a dried specimen, may have been owing to accident. Its tail is covered with long dirty yellow hairs, tipped with white, having the ends dusky; the throat, breast, and belly are white; the fore-feet have only four toes. It is uncertain whether this animal possesses the orifice under the tail. In each jaw there are six fore teeth, one tusk on each side of each, and four grinders on each side in both; in all thirty-two.

BADGER'S-BANE, — botanically *Aconitum meloctonum*. An ornamental, poisonous, perennial, tuberous-rooted shrub, of the monkshood genus. It grows to the height of 4 feet, produces blue flowers in June and July, and has a considerable resemblance to the common monkshood or well-known *Aconitum napellus*. It is a hardy exotic, and was first introduced to Great Britain in 1821.

BAERIA. A very beautiful, hardy, annual flowering plant, of the composite tribe. Only one species, the golden-mouthed, is as yet known to botanists; and this was introduced to Great Britain from California in 1835. It grows a foot high, has a yellow flower, and may be sown to bloom from April till June.

BAG. A curious remedy, in old farriery, for restoring or whetting the appetite of a horse. A small bag containing an ounce of asafœtida and an ounce of powder of savin was fastened to the horse's bit, and the animal was kept bridled for two hours, two or three times a-day; and as soon as the bag was taken off, he usually felt inclined to eat. One bag, of course, served for a long period.

BAGGING. The reaping of corn or pulse by

chopping it with the sickle. The reaper does not, as in the ordinary method, make a drawing cut, but he strikes and separates the stems by side cuts, hooks them up toward him, and then lays them on bands as in ordinary reaping. This method makes shorter stubble, or brings away more straw than the common method; but, unless carefully and dexterously conducted, it drops and disperses a greater number of stems.

BAIKIE. A species of binder, for attaching the cow to the stake. Two ropes connect a short bar of hard wood with a perpendicular stake, and are firmly fastened to the bar, but have an annular or sliding attachment to the stake; the lower rope passes under the neck of the cow, and is permanently attached to the stake; and the upper rope passes above the animal's neck, and is temporarily attached to the stake by means of a knot and eye. See the article *Cow-House*. The word *baikie*, in Scotland, is also the name of a kitchen four-cornered bucket.

BAIL. The security given for the defendant's appearance in a process. Bail is given both in civil and in criminal actions. In civil cases, until the passing of the act 2^o Will. IV. cap. 39, bail was either *common* or *special*. Common bail was taken when the defendant had been served with a writ of *capias*, by the sheriff or his officer, and with notice to appear, by his attorney, in court, to defend the action. If the defendant thought proper to appear upon this notice, his appearance was recorded, and he put in sureties for his future attendance and obedience. These sureties were called *common bail*, being the same two imaginary persons, John Doe and Richard Roe, that were pledges for the plaintiff's prosecution. And if the defendant did not appear upon the return of the writ, or within a short period after, the plaintiff might enter appearance for him, and file common bail in his name, as if the defendant had done so himself. By the act 2^o Will. IV., the appearance of the defendant is by entering a memorandum that he either appear in person or by attorney.

Common bail was taken only in actions of small concernment. But in causes of greater weight, such as actions upon bond or specialty, &c., where the plaintiff makes affidavit, or asserts upon oath, that the cause of action amounts to £20 or upwards, the defendant must put in substantial sureties for his appearance, which is called *special bail*. And in such cases it is required by 13^o Car. II. st. 2, cap. 2, that the true cause of action shall be expressed in the body of the writ or process. Upon the return of the writ, or within four days after, the defendant must appear, according to the exigency of the writ. This is done by putting in and justifying bail to the action; which is commonly called putting in bail *above*. If this appearance be not made, and the bail taken by the sheriff *below* are responsible persons, the plaintiff may then take from the sheriff an assignment of the bail-bond, and bring

an action against the sheriff's bail. And if the bail accepted by the sheriff be insolvent or unqualified persons, the plaintiff may have recourse against the sheriff himself. The general qualification of special bail, is that they shall be householders or freeholders. No attorney, attorney's clerk, sheriff's officer, or bailiff, can become bail.

The bail *above*, or bail *to the action*, must be put in either in open court, or before one of the judges of that court; or if, in the country, before a commissioner appointed for that purpose, and transmitted to the court. The bail, or sureties, to the number of two at least, must enter into a recognizance before the judge or commissioner, whereby they jointly and severally undertake, that if the defendant be condemned in the action, he shall pay the costs and condemnation, or render himself a prisoner, or that he will pay it for him: which recognizance is transmitted to the court in a slip of parchment, entitled a *bail-piece*. And the bail, if required, must *justify* themselves in court, or before the commissioner in the country, by swearing that they are housekeepers, and each of them worth double the sum for which they are bail, after paying all their debts. This practice is in some degree analogous to the *stipulatio* or *satisfactio* of the Roman law.

Bail, in criminal cases, is taken in most offences inferring an inferior degree of guilt; but not in felonies, and other capital crimes, because, in these cases, no bail could be a security equivalent to the actual custody of the offender's person. Both by the common and statutory laws, it is an offence against the liberty of the subject, for any magistrate to refuse or delay to bail any person bailable; and it is expressly declared, by statute 1^o W. & M. st. 2, cap. 1, that excessive bail ought not to be required; but it must be left to the courts to determine, according to the circumstances of the case, what bail shall be called excessive. Bail may be taken either in court, or, in some particular cases, by the sheriff, coroner, or other magistrate, but most frequently by the justices of the peace. Bail can be taken only where the imprisonment is for safe custody before conviction, and not from prisoners already convicted. By the old common law, all felonies were bailable, till murder was excepted by statute; so that persons might be admitted to bail, before conviction, almost in every case; but the power of bailing in treason, and in divers instances of felony, has been taken away by sundry statutes. It is agreed, however, that the court of King's Bench, or any judge of that court in time of vacation, may bail for any crime whatsoever, whether treason, murder, or any other offence, according to the circumstances of the case. The statute 7^o Geo. IV. cap. 64, is now the ruling statute as to bail in felony.

BAILIFF. An officer appointed for the administration of justice within a certain district. The office, as well as the name, appears to have been derived by us from the French; and it is

probable that our sheriffs of counties were also anciently called *bailiffs*, as a county is still often called *balliva*, or *bailiwick*. In the statute of Magna Charta, c. 28, and 14^o Edw. III. c. 9, the word *bailiff* would appear to comprehend sheriffs, as well as bailiffs of hundreds. As the kingdom is divided into counties, so every county is divided into hundreds, within which, anciently, the people had justice administered to them by the several officers of every hundred, who were the bailiffs. And it appears from Bracton, that bailiffs of hundreds might anciently hold plea of *appeal* and *approvers*. But these hundred courts, certain franchises excepted, have been, since that time, swallowed up by the county courts; and the bailiff's name and office is now grown into contempt, they being, in general, merely officers or messengers employed to serve writs, &c., within their liberties. In other respects, however, the name is still in good esteem; the chief magistrates in many towns being called bailiffs: and sometimes the persons to whom the care of the king's castles is committed, are termed bailiffs; as the bailiff of Dover castle, &c. The ordinary bailiffs are of several sorts:—

Bailiffs of liberties, are those who are appointed by every lord within his liberty, to execute processes, &c. Bailiffs of liberties and franchises are to be sworn to take distresses, truly impanel jurors, make returns by indenture between them and sheriffs, &c., and are liable to punishment for malicious distresses, by fine and treble damages.

Bailiffs of sheriffs, or sheriff's officers, are either bailiffs of hundreds, or special bailiffs. Bailiffs of hundreds are officers appointed by the sheriffs to collect fines in their respective districts; to summon juries; to attend the judges and justices at the assizes and quarter-sessions; and also to execute writs and processes in the several hundreds. But as these bailiffs of hundreds are generally plain men, and not thoroughly skilful in this latter part of their office, it is now usual to join *special bailiffs* with them. The sheriff being answerable for the misdemeanours of these bailiffs, they are therefore usually bound in a bond for the due execution of their offices, and are thence called *bound bailiffs*; which the common people have corrupted into a much more homely appellation.

Bailiffs of lords of manors, are those that collect their rents, and levy their fines and amercements. Such bailiffs can bind their lord by such acts as are for his benefit; but they require to act on special authority in other cases, &c.

Bailiffs of courts baron, summon those courts, and execute the process thereof, &c.

Bailiffs of husbandry, are the officers belonging to private persons of property, who superintend the inferior servants, regulate their labour, &c.

A *water bailiff* is an officer anciently established in all sea-port towns, for the searching of ships, by 28^o Hen. VI. cap. 5. Such an officer still exists in the city of London, who supervises and

searches all fish brought thither, and gathers the toll on the river Thames. He also attends the lord-mayor in his excursions by water, and marshals the guests at table. He can also arrest for debt, &c., on the river Thames, by warrant of his superiors.

There are different other denominations of bailiffs to be met with in this and other countries; such as, *provincial*, *royal*, *itinerant*, and *heritable bailiffs*; *bailiffs* of France, of the empire, of boroughs, &c.

BAIT. A feed of oats or other provender, accompanied with a brief rest, during labour or travelling. Also, a lure for catching a fish or a wild land-animal.

BAITING OF ANIMALS. The atrocious practice of setting a small spirited animal to bite and torment a large and dull one, at the risk of being gored. The animals usually employed are the dog to bait and the bull to be baited. Bull-baiting, as the horrid practice is called, was formerly a public sport in England, and continues to be a public sport of even the higher classes of society in Spain. It is supposed to have first occurred in this country, at Stamford, in 1209, in the reign of John, and to have been made a custom or usage of the manor of Tutbury in Staffordshire in 1374; but, in consequence of the laudable opposition of the Duke of Devonshire, who was steward of Tutbury, and of a number of the population who petitioned against it, the Tutbury bull-baiting was abolished in 1778. Bear-baiting, in the latter part of the 15th century and early part of the 16th, was practised for the brutal amusement, not only of the common people, but of the royal court. We cannot, without an outrage upon all right feeling, describe either the manner or the usual incidents of a bull-baiting; but will rather quote an eloquent invective against it, uttered in 1801, by the celebrated Dr. Barry: "What a prodigy must he be in a Christian land, who can disgrace his nature by such gigantic infamy, at which the blood of a heathen, of a very Hottentot, might curdle! Two useful animals, the bull who propagates our food, and the faithful dog who protects our property, to be thus tormented! And for what purpose? Does it tend, as some have said, to keep alive the spirit of the English character? In answer to this we must remark, that the barbarous sport, if sport it can be called, was unknown to the ancient bravery of our ancestors,—was introduced to this country in the reign of a bad king; and earnestly do I pray to Almighty God, that, in the reign of a most pious and benevolent prince, it may be for ever set aside. Cowards, of all men the least unmoved, can both inflict and witness cruelties. The heroes of a bull-bait, the patrons of mercenary pugilists, and the champions of a cock-fight, can produce, I should think, but few if any disciples brought up under their tuition, who have done service to their country either as warriors or as citizens; but

abundant are the testimonies which have been registered at the gallows of her devoted victims trained up to these pursuits." The drift of this invective, and of the whole sermon in which it occurs, was to put an end to an annual bull-baiting at Wokingham, in Berkshire, which some monied savage had bequeathed property, in 1661, to establish and maintain.—*Daniel's Rural Sports.*

BAKING OF BREAD. The art of reducing meal or flour of any kind, or any other substance, into bread. This art, simple and necessary as it may appear, does not seem to have been discovered till a late period in the history of mankind. The earlier nations knew no other use of their meal than to make of it a kind of porridge. Such was the food of the Roman soldiers for several centuries, or at most their skill proceeded no farther than to knead unleavened dough into biscuits or cakes. Even at present there are many countries where the luxury of bread is unknown. To bake bread properly requires many precautions, and a degree of skill which can only be gained by considerable practice. It is owing, perhaps, to this circumstance, that those who first began to pursue baking as a profession, have, in their several nations, been held in very high respect. At Rome—into which regular bakers seem to have been introduced from Greece, about the year of the city 583—they were so much esteemed as to be occasionally admitted into the senate. To preserve them more upright and honourable, they were expressly forbidden to associate with gladiators or comedians; and to enable them to devote their whole time to their proper business, they were exempted from guardianships and other offices to which the rest of the citizens were liable. To the foreign bakers who first practised this art in Rome, a number of freedmen were added, forming together an incorporation, or college, from which neither themselves nor their descendants were allowed to withdraw: even their effects were held in common, and no part of them could be alienated. Each bake-house was under the superintendence of a patron, and one of the patrons was annually elected to preside over the rest, and take charge of the general concerns of the college. By the statutes of England, too, bakers are considered as superior to the general order of handicrafts. "No man," says the 22^o Henry VIII., cap. 13, "for using the mysteries or sciences of baking, brewing, surveying, or writing, shall be interpreted a handicraft." In London, and indeed in most of the towns throughout the kingdom, they are under the jurisdiction of the magistrates, who regulate the price of bread, and have the power of fining those who do not conform to their rules. The two kinds of bread made in London are distinguished by the names of *white*, or *wheaten*, and *household*, which differ only in their degrees of purity. The ingredients of bread are flour, yeast, water, and salt, which are mixed according to

the following process:—To a peck of flour are added a handful of salt, a pint of yeast, and three quarts of water, which in hot weather must be cold, in winter hot, and in temperate weather lukewarm. The oven must be heated more than an hour before the bread is introduced, which must remain there three hours to be properly baked. For further particulars concerning bread, and the substitutes used for it in various nations, see article **BREAD**.

BAKING OF LAND. The forming of a hard skin or crust on the surface of adhesive, tenacious, and finely pulverulent soils. The skinning or baking is, in some instances, gradual and uniform, and, in others, sudden and merely occasional. When it is gradual and uniform, it results from the excessively argillaceous nature of the soil, which always prevents in a greater or lesser degree the necessary aeration of the soil, and can be prevented, or even tolerably well corrected, only by altering the mechanical condition of the soil by the intermixture of sand, lime, or other arenaceous or calcareous substances. When it is sudden and merely occasional, it occurs in dry, strong, loamy soil, soon after sowing, or before the soil has had time to settle, and in consequence of first a fall of rain and next a play of sunshine; and it frequently, to the great damage of the crop, prevents the plumules or young stems of the corn-plants from coming up; but is usually prevented by the practice of rolling after sowing,—a practice which so consolidates the soil as to render sudden wetting and drying by successive rain and sunshine impossible. Land which is subject to being baked, and which cannot conveniently be improved, ought to be sown, as often as a judicious rotation will permit, with winter wheat or vetches.

BALANCE. The name of a simple machine for ascertaining the weight of any body, or for finding a quantity of any substance equal to a given weight. The balance has generally been arranged among the mechanical powers, but it is evidently only a particular species of the lever in which the two arms are equal, and in which there will be an equilibrium when the power and weight are equal. The balance consists of a horizontal beam, which turns round an axis or centre of motion exactly in the middle of the beam. The two halves of the beam, on each side of the axis, are called the *arms* of the balance. From the two extremities of the beam, called the *points of suspension*, are hung two scales, in one of which is placed the substance to be weighed, and in the other are placed weights of a known magnitude. The equality of the weights in the two scales, or the perfect equilibrium of the balance, is known from the horizontal position of the beam. In the common balance, where the whole machine is suspended from the axis of motion, a slender arm, called the *tongue* of the balance, rises perpendicularly from the centre of the beam, and points to a particular part of the handle by which the

whole is suspended when the beam is horizontal.

The perfect equality of the two weights thus placed in equilibrio cannot, however, be a matter of certainty, unless we know that the two arms are exactly equal. In order to determine this, we have only to make the weights and the body weighed change places; and if the arms are unequal, there will no longer be an equilibrium. By this means, we only ascertain that the balance is imperfect; but we may, by a very simple process, find the exact weight of any body P by an imperfect balance. For this purpose, let us suppose that the body P, placed in the left hand scale, is exactly balanced by the weight W in the right hand scale. Take out P, and substitute in its place a weight P', which exactly balances W; then, though, from the known inaccuracy of our balance, P is not equal to W, nor P' equal to W, yet P is equal to the weight P', because they are both in equilibrio with the same weight W, in the same circumstances.—The Roman steelyard is an instrument for finding the weights of different bodies, by means of a single weight, which is placed at a greater or less distance from its fulcrum, or centre of suspension. It consists of a scale, and sometimes of a hook placed at the end of the shorter arm for carrying the body to be weighed, and of a weight which is made to slide along the longer arm. When the body to be weighed is suspended at the end of the shorter arm, the constant weight is slipped along the long arm, till the equilibrium is indicated by the tongue or index. When this is effected, the number at the point at which the weight rests, indicates the weight of the body. The Danish and Swedish steelyard is a lever with a constant weight fixed at one extremity, and a scale for holding the body to be weighed at the other extremity. The point of suspension is therefore variable, and is generally a ring, which is moveable along the lever till an equilibrium takes place.

In balances where very great accuracy is required, the beam is not supported by suspension, but has a fine edge of steel for its axis, which rests upon steel planes. The horizontal position of the beam is in this case determined, by observing when the extremities of the arms point to the zero of two ivory scales fixed in the mahogany frame in which the instrument is placed, the line joining the two zeros having been previously placed in a horizontal position, by levels fixed in a mahogany frame. The beams of these delicate balances sometimes consist of a plain cylindrical rod, of a double cone, whose vertices form the points of suspension, or of a frame in the form of a rhombus.

BALANINUS. A genus of insects, of the weevil tribe. One of the species inhabits the acorn; and hence the name *balaninus*, which is derived from a Greek word meaning an acorn, is applied to the whole genus. But the species best known to cultivators of the soil is *Balaninus nucum*, or

the nut weevil. This species is described as follows by Mr. Stephens:—"Slightly depressed, black, densely clothed with flavescent or griseous pubescence, with deeper shades and irregular fasciæ; head furnished with a very long and slender rostrum, which is outwardly rufous; thorax subcarinated; scutellum flavescent or whitish; elytra (not covering the extremity of the abdomen), punctate-striated, the interstices thickly rugulose; body beneath also pubescent, with the pubescence very dense on the anterior angles of the breast; legs dull ferruginous, the joints somewhat piceous; femora acutely dentate; antennæ dull ferruginous; length, from three to five lines." Its form and appearance—as well indeed as those of the whole genus—exhibit a close resemblance to the genus *Anthrenus*; but the proboscis is as long as the whole body, very slender, and considerably arched. Early in August, when the hazel nut is soft and immature, the female of the *Balaninus nucum*, with her long polished beak, drills a hole in the nut, and, by means of her ovipositor, introduces an egg through the hole; in the course of about a fortnight, the larva is hatched, and begins to feed upon the kernel and the surrounding pulp; and when full grown, it either widens the hole through which the egg was deposited, or bores another hole with its mandibles, and egresses to bury itself in the earth, and there effect its transition through the state of a pupa to that of a beetle. The larva is short, thick, and fleshy; it lies, when at rest, in the form of a semicircle; it has neither hairs nor bristles, but is thickly covered with minute tubercles; and it does not appear to have either eyes or legs. The pupa is of a pale colour; it has two projecting points at its hinder extremity; and its head and its rostrum are distinctly formed. Either *Balaninus nucum*, or some insect so like it as to have been mistaken for it, has of late years attacked the plants of some English vine-ries. It abounds on the continent and in some districts of England, but is comparatively rare in Scotland. One of the best methods of destroying it is, in the end of June or the beginning of August, to shake the bushes or beat them with a pole, and to collect the insects as they fall either in an insect-net held below the bushes, or on a sheet spread upon the ground.—*Illustrations of British Entomology*.—*Quarterly Journal of Agriculture*.—*London's Gardener's Magazine*.

BALK. A piece of arable land left unploughed, either through careless management, or by prodigal waste, or with design to serve as a boundary, or for some other purpose. Balk is also the name of the summer-beam or dorman of a house; and balks or bawks are poles laid over a stable or other building for a roof.

BALL. Any thing rotund or globular. But the word is technically used in farriery to designate a cylindrical or egg-shaped mass of medicine, tightly skinned with paper, and administered as a dose to a horse. A ball, in this techni-

cal sense, has the same convenience of form in farriery, as a pill has in medicine for the human subject. It may, of course, be exceedingly varied in composition, but it ought to be made up with oil rather than with honey or syrup, and to be administered with only a thin pellicle of oiled paper and in as fresh a state as possible, before it has had time to harden. It ought never to weigh more than an ounce and a-half, or to measure more than an inch in diameter, and three inches in length. An instrument called a balling-iron is sometimes used for administering it; but is quite as likely to inflict mischief as to afford facility. The best method of administration is described as follows by Mr. Youatt:—"The horse should be backed in the stall; the tongue should be drawn gently out with the left hand on the off side of the mouth, and there fixed, not by continuing to pull at it, but by pressing the fingers against the side of the lower jaw. The ball, being now taken between the tips of the fingers of the right hand, is passed rapidly up the mouth, as near to the palate as possible, until it reaches the root of the tongue. It is then delivered with a slight jerk; and, the hand being immediately withdrawn and the tongue liberated, the ball is forced through the pharynx into the œsophagus. Its passage should be watched down the left side of the throat; and if the passage of it is not seen going down, a slight tap or blow under the chin will generally cause the horse to swallow it, or a few gulps of water will convey it into the stomach." White says, with respect to the hard or soft state of a ball, "it should be made more or less soluble, according as we wish it to operate upon the stomach, large intestines, or rectum: for those medicines which—like gamboge—are readily dissolved in the stomach, are quick and violent in their effects, and liable to derange the functions of this viscus; while those, on the contrary, which are not so easily soluble, pass through a large portion of the intestinal canal before they take effect. Thus colocynth, whose active principles reside both in soluble and insoluble elements, has a wide range of operation; and aloes, which are still farther insoluble, pass through the whole alimentary canal before they are sufficiently dissolved, and, consequently, act more especially upon the rectum than any other bowel. This enables the practitioner to vary the effects of different medicines, by rendering them more or less soluble; and we know by experience that the operation of aloes is quickened, and its tendency to irritate the rectum diminished, by combining it with soap or an alkaline salt. Thus, when it is wished to empty the large bowels only, and aloes be administered for this purpose, they should be sufficiently softened with water or treacle to cause them to act with greater expedition. With respect to cordial balls, they should always be made very easy of solution, as they are intended to act principally on the stomach; and those balls that contain turpentine, or any resin-

ous substance, should always be combined with soap, otherwise they become very hard and are dissolved with difficulty. When many balls are made at one time, great care should be taken to mix the powders well together before they are formed into a mass, in order that all the balls may contain an equal proportion of the ingredients of which they are composed."

BALLOTA, — popularly *Stinking Horehound*. A genus of hardy, perennial, herbaceous plants, of the labiate tribe. They are closely related to the horehound and motherwort genera; and derive their name from the offensive circumstance of their having a fetid smell. Both the black and the white species are weeds of Britain, infesting hedges, and growing to the height of two feet. The common, the two-rowed, and the gray species have been introduced from respectively Continental Europe, India, and Nepaul; the oriental and the woolly species are now regarded, the former as a horehound, and the latter as a motherwort; and an ornamental species, called the elegant or the ashy, was introduced a few years ago from Nepaul.—*Ballota* is also the botanical specific name of the sweet acorn, an ornamental deciduous tree of the holly genus, a native of Barbary, and growing to the height of between 20 and 30 feet.—*Ballota* is likewise the botanical specific name of the Barbary oak, an evergreen timber tree of the oak genus, a native of Barbary, and growing to the height of about 60 feet.

BALM,—botanically *Melissa*. A genus of hardy, herbaceous plants, of the labiate family. Its botanical name *melissa* means a bee, and alludes to an abundant secretion of honey. Three species of recent introduction are cultivated for ornament; and the heart-leaved species, also of recent introduction, is cultivated for medicinal purposes; but the garden, common, officinal, and well-known species, *Melissa officinalis*, is cultivated at once for the pleasant lemon odour of its leaves, and for the uses of medicine and the kitchen. Two species formerly included among the balms are now assigned to the catmint genus; and three other species formerly included among the balms are now assigned to the calamint genus. The officinal species grows wild in the south of Europe and on the mountains near Geneva, and was introduced to Great Britain during the latter half of the 16th century. Its stem is angular and branching, and grows to the height of from 12 to 24 inches; its leaves are large and indented, and grow in pairs at the joints of the stem, the lower ones standing upon long footstalks; and the flowers are white, bloom from June till October, and grow in loose small bunches at the wings of the stalk, in whorls standing upon single footstalks. Its principal varieties are the Roman, with soft hairy leaves, and the variegated, with striped leaves. The plant has long been esteemed cordial, cephalic, and good for most disorders of the head and nerves, and has been employed for

the preparation of tea and of a medicinal water. It is easily propagated by dividing the root; and it needs no other culture than being kept clean from weeds, and being deprived of its decayed stalks in autumn.

BALM (BASTARD),—botanically *Melittia*. A small genus of hardy, herbaceous, sweet-smelling plants, of the labiate tribe. It is very nearly allied to the balm genus, and derives its botanical name from the same pleasant characteristic feature. The melissa-leaved species, or common bastard balm, *Melittis melissophyllum*, grows wild in the woods of England, has a height of about a foot, and produces a flesh-coloured flower in May and June. The great flowered species, *Melittis grandiflora*, also grows wild in the woods of England, and produces a white flower in May. A plant of either of these species, when beginning to be dry, is highly fragrant.

BALM (MOLDAVIAN),—botanically *Dracocephalum Moldavicum*. An ornamental annual plant, of the dragon's-head genus. It is a native of Moldavia, and was introduced to Great Britain about the end of the 16th century. Its stem grows to the height of 18 or 24 inches; its leaves are oblong and serrated; and its flowers appear in whorls round the stem at every joint, and bloom in July and August. The normal plant has blue flowers; and a widely diffused and quite permanent variety has white flowers. Moldavian balm has a strong balsamic fragrance. Most of the old-introduced species of dragon's-head appear to have been at one time called Moldavian balm.

BALM OF GILEAD,—botanically *Dracocephalum canariense*. A tender, tuberous-rooted, ornamental plant, of the dragon's-head genus. It is a native of the Canary Islands, and was introduced to Great Britain about the end of the 17th century. Its popular name seems to allude to a strong resinous fragrance which its leaves emit on being rubbed. Several square stems rise from each root to the height of about 3 feet, and are ligneous in their lower parts; the leaves are compound, oblong, pointed, serrated, three-lobed or five-lobed, and situated in opposites at the joints of the stems; and the flowers are of a pale blue or pale purple colour, and are produced in short thick spikes on the top of the stems. Though classed as a greenhouse plant, it can live through many a winter in a sheltered border in most parts of England. It is propagated from either seeds or cuttings. See **BALSAMODENDRON**.

BALM OF GILEAD FIR. See **FIR**.

BALSAM,—botanically *Balsamina*. A genus of very beautiful, tender, annual plants, forming the type of the natural order Balsaminaceæ. This order, however, includes only the additional species *impatiens*, and was formerly treated as one genus, under the name of *impatiens*. All the species, with only one exception, are annuals; they amount to upwards of thirty; they are principally natives of tropical countries; and they are

remarkable for the brilliance, variegations, and singular appearance of their flowers. Their habit is peculiar; and their florification, their embryo, and their capsule, resemble those of respectively the fumitory, the flax-plant, and the wood-sorrel. Nearly twenty species of the genus *balsamina* are known to botanists; ten have been introduced to Great Britain; and nine of these ten have been introduced within the last thirty years. The longest and best known species, often called emphatically the balsam—*Balsamina hortensis*—but formerly *Impatiens balsamina*—is hardier and taller than the other species, yet sufficiently resembles them to be an accurate type of the whole. It is a native of the East Indies, and was brought to Great Britain about the end of the 16th century. Its stem is succulent, branchy, and semi-pellucid, and rises from the height of from one foot to three feet; its leaves are long, spear-shaped, and serrated; and its flowers are large, delicate, very diversified in colour, but usually white, red, or striped, and bear a considerable resemblance to those of the carnation, but are much more delicate in both tint and texture. So exceedingly playful is the plant, that no two plants of one sowing bloom alike,—the flowers differing in doubleness, in size, in profusion, and particularly in colour and tint. It and the coxcomb are at present the most fashionable tender annuals in cultivation; it is annually raised in great numbers in pots for placing in windows, plunging in borders, and contributing to the summer and autumn occupancy of greenhouses; it is easily raised in good soil, in the usual manner of tender annuals; and it has, of late years, been successfully propagated from cuttings for blooming in winter. The cuttings are treated in the same manner as the pipings of pinks, and may be struck in a rather long succession, from midsummer to an advanced period in autumn. If treated with artistic skill, the flowers of their plants may be remarkably double, and as large as a crown-piece; but if badly treated, they will either not succeed, or produce tiny plants, and utterly worthless flowers.

BALSAM (YELLOW). See **TOUCH-ME-NOT**.

BALSAMODENDRON. A genus of oriental balsamic trees, of the turpentine-tree tribe. Five species have been described by botanists, but only one, the Ceylon species, has been introduced to the hot-houses of Great Britain. The species *opobalsamum* and *Gileadense*, yield opobalsamum, balm of Gilead, or balm of Mecca, by incision of their trunk, xylobalsamum by the boiling of their branches, and carpobalsamum by pressure of their fruit; and in the periods of sacred history, they possessed a celebrity in Canaan, but now are no longer to be met with, even in gardens, in the vicinity of Gilead. The species *myrrha* and *katof*, natives of Arabia, yield the well-known myrrh of scripture, and of commerce; and the red and resinous timber of the latter is a common article of sale in Egypt. The Ceylon species, *Zeylani-*

cum, formerly called *Amyris Zeylanica*, will grow with us to the height of 30 feet, and is propagated from cuttings in peat and loam.

BALSAM-POPLAR, or **TACAMAHACA**,—botanically *Populus balsamifera*. A timber tree of the poplar genus. It is a native of North America, and was introduced to Great Britain near the close of the 17th century. It grows to the height of about 70 feet, and has an imposing and even majestic appearance. A shoot of it has been known to grow ten feet in one summer, with a diameter near the base of about an inch. A young shoot has five angles; but the bark of these angles is so extended by future growth, as to leave only traces of the angles in the older branches. The bark of the tree is smooth, and of a whitish colour. Hanbury, first referring to the angles of the young shoots and then noticing the whole tree, says, "This gives the tree in winter a particular look; for at the base of each bud, they curve over and meet. Thus there will be between every bud, formed by the bark, figures like niches, as it were, of public buildings, though with an upright in the middle, at the top of each of which, like an ornament, is seated the bud, for the future shoot or leaf. These buds are only to be found on the younger branches; but the figure is retained on the bark of the older without those ornaments. But of all the trees in a collection, none more agreeably by its leaves entertains us than this, whether we consider their colour, figure, or size. The colour is a light, shining green, which is heightened in the autumn by the strong midrib, and the large veins that issue from it, turning to a red colour; the lesser veins also being in some degree affected, occasions upon the same leaf a sweet contrast. Their figure nearly resembles that of a heart; and they are notched at their edges. But the chief majesty this tree receives is from the size of the leaves. I have measured some of the younger trees, and found the leaves ten inches long and eight broad, with a strong footstalk of four inches in length. These majestic leaves are placed alternately on the branches, though, as the tree advances in height, they diminish in size. This species shoots late in the autumn; and these young shoots have their ends often killed in hard winters; which is an imperfection, as it causes the tree to have a very bad look in the spring, before and when the leaves are putting out. However, these last will not fail afterwards to make ample amends for the former defect. The flowers afford no pleasure to the gardener; they are only catkins like other poplars, and fit only for the curious botanist's inspection." The balsam-poplar, like most of its co-species, sends up numerous suckers from its decurrent roots, and is very easily propagated either from these suckers or from cuttings. An adhesive, strong-smelled resin covers the buds of this tree, and gives rise to its name.

BALSAMS. This term was formerly applied to all liquid vegetable resins as well as to many

pharmaceutical preparations; but, to avoid confusion, the French chemists confine the term *balsam* to vegetable substances composed of benzoic acid with more or less volatile oil. But as this would exclude copaiva and some other substances, popularly called balsams, most of the German chemists retain the old acceptation of the term, and divide balsams into those which do not and those which do contain this acid. To the former, which also are called oleo-resins, liquid resins, or terebinthines belong. The different turpentine (including Canada-balsam), copaiva, and opobalsamum or Mecca-balsam, are semiliquid resinous or glutinous juices, which flow spontaneously or by incisions from various vegetables, especially those belonging to the orders Coniferæ, Terebinthaceæ, and Leguminosæ. They have a hot and acrid taste, and a strong odour, which, in some, is very fragrant, in others less agreeable, but peculiar. They consist of a volatile oil and resin. Their odour, their semiliquidity, and much of their medicinal activity, are owing to the volatile oil which they contain, which may readily be procured from them by distillation, and which volatilizes by exposure to air, whereby they become hard. From the next, or true balsams, they are distinguished by not yielding benzoic acid. Those balsams which contain benzoic acid or balsams, more properly so called, are solid, soft, or liquid substances, according to the quantity of volatile oil which they contain: they have an aromatic, usually agreeable odour, and a warm acrid taste. They dissolve in alcohol, and the solution, when mixed with water, becomes milky, owing to the precipitation of resin. By sublimation, as well as by other methods, they yield benzoic acid. They owe their principal medicinal activity to the contained benzoic acid. They are obtained principally from the orders Styracæ, Leguminosæ, and Balsamaceæ. To this class belong benzoin, styrax, tolu, Peruvian balsam, and liquid amber. The natural production, called Chinese varnish, belongs also to this class.

BALSAM-TREE,—botanically *Clusia*. A genus of tender, evergreen, ornamental trees, of the guttiferous tribe. Four species have been introduced to the hot-houses of Great Britain; and about a dozen more have been described by botanists. The rose-coloured and longest known species, *Clusia rosea*, is a native of Carolina and the West Indies, and usually grows to the height of about 30 feet. It sports itself into numerous seminal varieties, with different colours and sizes of both flower and fruit. Its stem ramifies on all sides into numerous branches; its leaves are single, round, and succulent, and occur in pairs, or opposites; and its flowers have thick succulent covers, and are produced at the ends of the branches. A balsam resembling turpentine exudes from every part of this tree, and has been much used as a plaster for the cure of sciatica. The West Indians call this balsam hog-gum, from a

belief that wild-hogs rub themselves against it to obtain a cure of their wounds.

BAMBOO,—botanically *Bambusa*. A genus of very gigantic exotic grasses, of the reed or bamboo tribe. Upwards of thirty species have been described by botanists, a considerable number more are believed to exist, and probably about a dozen are occasionally grown in the hot-houses of Great Britain; but some have been assigned by botanists of the present day to other and recently-erected genera. They have a singularly interesting appearance, a great commercial value, and an exceedingly diversified and paramount economical importance; and yet they are imperfectly understood by botanists. A strong, jointed, creeping, subterranean root-stock serves as the trunk or stem; and strong, light, graceful, straight, rod-like, shoots, soaring from the root-stock to a great height, appear to be stems, and are popularly called so, but really possess the character of branches. When these have attained their full height, they send off horizontally, or at right angles from themselves, a series of rigid lateral branches; and any full-grown series of shoots and offshoots, or of chief vertical branches and subordinate horizontal ones, is in consequence a dense tuft of rigid, straight-lined vegetation. The shoots are externally hard and coated with a powerful silicious secretion, resembling flint; they are internally a series of cylinders, separated from one another at the nodes by strong horizontal partitions; and the cylinders are occupied generally with water, but sometimes with an opaque, white, flinty secretion, called tabasheer, and possessing some curious optical properties.

The reed-like bamboo, *Bambusa arundinacea*, is the species longest and best known, and most diversifiably economical; it was introduced to the hot-house cultivation of Britain from India, upwards of a century ago; it usually grows to the height of about 40 feet; it has been somewhat successfully tried, even in Scotland, in the open air against a south wall; and it is propagated from suckers in a good loamy soil. It is employed in India, whole, split, or in sections, for house-building, house-thatching, scaling-ladders, rails, palankeens, wicker-work, mats, baskets, boxes, spear-shafts, bows, fishing-rods, carriers' tents, boat-frames, and many other purposes. The young shoots, when small and tender, are generally eaten in the same manner as asparagus, or boiled with milk, or made into broth with animal food, spices, salt, and water, or prepared and digested in the manner of a pickle.—Most of the other species known in Britain are, like the *Bambusa arundinacea*, from India, but usually do not attain more than half its height, and, with probably one exception, they are esteemed ornamental.

Several species of bamboo are natives of America, and may not improbably be naturalizable, and made subservient to some valuable economical purposes in Great Britain. "The bamboos of America," says Humboldt, "offer the same ad-

vantages as in India. The *Guadua* bamboo is solely employed for the construction of entire houses. The oldest and largest stalks serve to form the walls; with the smaller ones the inhabitants form the main roof. The upper covering is composed of the young branches of the plant, furnished with leaves as they are, and of which they put many layers one over the other. The doors, the tables, even the beds, are made of bamboos. The advantages which the inhabitants of America find in making use of the plant, rather than of the very lofty and very hard timber which surrounds them, are, first, the facility with which they cut them, and transport them to very great distances; second, the small degree of labour which is required, since the inhabitants employ the plants entire, or only split lengthways into two parts; third, in its durability, which may be compared to that of the best timber; fourth, and lastly, in the circumstance that their houses, all open to the air, and protected from the heat of the rays of the sun by a wide and thick roof, preserve within doors a cool and agreeable temperature in the midst of the strongest heat of the day. It is particularly in the mountain of Quindu, that the *Guadua* bamboo grows; it forms forests of many leagues in extent, and appears to delight in elevated situations, which offer a mild temperature. It descends also into the very hot valleys, but is never seen on the high mountains. We have cut a great number of bamboos, and in all of them we have found clear water of an agreeable taste." The *Bambusa Guadua* frequently attains the stupendous height of from 65 to 100 feet. The series of hollow cylinders within its stem is somewhat regularly divided by the nodes or partitions at distances of from 11 to 12 inches. The water within these cylinders, though containing traces of sulphates and chlorides, cannot be distinguished from the purest water of springs, and affords a convenient and most grateful supply to travellers.

The bogs and marshes of the southern counties of England and Ireland may possibly, in a few years, be used for the highly profitable culture of the American bamboos, while the adjacent fields may be occupied with the arracacha from the same land; and then longer and lighter stilts and leaping-poles than at present will be furnished to fenmen, more magnificent cover for wild fowl, better poles for punts and barges,—better spars for vessels,—lighter, stiffer, and more portable materials for bridges, rafts, hurdles, fences, and stack-supports,—superior shafts for wheel-carriages, for scaffolding-poles, rafters, roof side-timbers, flooring-joists and beams,—and a better material for every other purpose in which an elastic, stiff, straight, and durable material is required.—*Humboldt's Plantes Equinoctiales*.—*The Materia Medica of Hindostan*.—*London's Gardener's Magazine*.—*Boussingault's Rural Economy*.

BAMPTON-NOTT. A long-woolled breed of

sheep, found in the fertile valleys of Devonshire and Somersetshire, and named from the village of Bampton, near the boundary-line between these counties. See SHEEP.

BANANA-TREE,—botanically *Musa sapientum*. A tropical, endogenous, fruit-tree of the plantain-tree genus, but with the appearance and character of a gigantic, evergreen, oriental-looking herb. It seems to have been carried from Guinea to the Canary Islands, and from the latter to the West Indies; it is cultivated in Egypt, in Mexico, and in most other hot countries of both the old world and the new; and it was introduced to Great Britain in 1729, and is now cultivated for its fruit in the large stove-houses of some of our choicest gardens. Its stem has a soft herbaceous appearance, grows to the height of about 20 feet, has the thickness of a man's thigh at the lower part, diminishes gradually to the top, and is marked with dark purple stripes and spots. Its leaves are often 6 feet long, and 22 inches broad, and sometimes much larger; they have a strong fleshy midrib, and many transverse veins thence to the border; they are thin and tender, and easily torn by the wind; they come out from the centre of the top of the stem; they at first are rolled up, but afterwards expand quite flat, and turn backward; and so rapidly do they grow, that if a fine line is drawn across, they will be seen, in the course of an hour, to have risen nearly an inch above it. The flowers are produced in bunches, and have a fine pink colour, and usually appear from March till October. The fruit is shorter, straighter, and rounder than that of the common plantain, or *Musa paradisiaca*, and has a softer pulp, and a more luscious taste; yet, though differing in size and other qualities with the several varieties of the species, it is always wondrously large and a most princely dessert.

The banana is a valuable edible fruit in every country in which it is cultivated in the open air; and, in particular, it forms the principal vegetable food of the Mexicans. Both the rapidity and the amount of its produce exceed those of every other known plant. In the course of 8 or 10 months after a sucker of it has been planted, clusters of fruit are formed; and in two months more, they are gathered. The stem is then cut down, and a fresh stem speedily grows to about two-thirds of the height of the former, and, in the course of about three months, bears fruit. The only culture required is to dig round the roots once or twice a-year. From 30 to 40 banana-trees, in Mexico, are planted on 1,076 square feet of ground, and, in the course of a twelvemonth, yield upwards of 4,400 lb. avoirdupois of fruit; and on the same space of ground, in the same space of time, wheat produces only 33 lb., and potatoes 99 lb.

A plant of the St. Helena variety of the banana in the Edinburgh Botanic garden, grows to the height of 14 feet, has very large leaves, and produces both a very large and a very richly flavour-

ed fruit. The average weight of each bunch of its fruit is from 60 lb. to 80 lb. A plant of the Dacca variety, in the same garden, grows to the average height of 7 feet, and produces bunches of fruit of from 10 lb. to 20 lb. in weight. The variety *Cavendishii* or *Chinensis*, fruits at a small size, and, on that account, is introducible to a stove-house of comparatively small dimensions; but, unless very great heat be given when it is developing its flower-spike, it has a great tendency to smother one half of each bunch of fruit in the folds of the leaves. Other varieties which have fruited in the Edinburgh Botanic Garden are the common banana, the French banana from Jamaica, and the strawberry-flavoured banana from the Mauritius, and several others recently introduced from the West Indies; and varieties which have flowered, but have fruited either not at all, or very poorly, are *discolor*, *rosacea*, *coccinea*, and *superba*. A fruiting banana in a British hot-house may, by proper treatment, be made to yield fruit within a twelvemonth of its being planted as a sucker. The sap of the banana, according to a chemical examination of it by Bous-singault, contains gallic acid, acetic acid, common salt, silica, and salts of lime and potash. It has a decidedly characteristic astringent taste, reddens tincture of litmus, and gives a yellow colour to stuffs immersed in it. Immediately after escaping from the plant, it is colourless and limpid like water; but, on being exposed to the air, it becomes turbid, and throws out flocculent matter of a dirty rose colour; and, after undergoing this change, it no longer has the power of making stuffs immersed in it yellow.—*Miller's Gardener's Dictionary*.—*Foreign Q. Review*.—*Bous-singault's Rural Economy*.—*Loudon's G. Magazine and Hortus Britannicus*.

BANDAGE. A strip of flannel, linen, or calico, used in farriery for keeping dressings to wounds, holding together separated parts, compressing blood-vessels, and supporting in their natural position weak and protruding parts of the body.

BANDS. Two stripes of wheat or other corn, twisted together at the ear-ends, and used as the binding of a sheaf. The bands ought to be laid in the morning, that they may not crack; for, after the sun is up, the strain loses its elasticity, and cannot properly be twisted, but becomes brittle and liable to break below the ears. The reversing of a few of the straws in each stripe, so as to place their stubble ends among the ears of the other strains, adds greatly to the strength and the toughness of the bands. But though the bands should always be made while the morning dew is upon them, they ought not to be spread out in moist weather, lest they should sprout and be wasted, nor ought the sheaves to be bound up moist, lest they become mouldy and spoil. Farmers and stewards sometimes pay insufficient attention to the binding of their sheaves, and suffer the reapers, for despatch, to tie the bands just

underneath the ears, and the consequence is that the sheaves can scarcely hold together to be flung into the cart, and are certainly in great risk of falling to pieces before they are thrashed.—The bands of a saddle are two pieces of iron, flat, and three fingers broad, nailed on the bows of a saddle, one on each side, to hold the bows in the proper saddle-shaped situation.

BANE. The rot in sheep. See article **ROT**.

BANEERRY, or **HERB-CHRISTOPHER**,—botanically *Actæa*. A small genus of perennial, ornamental, hardy, herbaceous plants, of the ranunculus tribe. The common herb-christopher or spiked baneberry, *Actæa spicata*, grows wild in the mountainous woods of Great Britain, and is particularly abundant in the woods near Kirby-Lonsdale, and in some parts of Yorkshire. It rises to the height of about 18 inches, the footstalks of its leaves are long, and arise from the root; its subordinate footstalks and its lobes make a successive threefold division, so as to form a compound leaf of twenty-seven leaflets or lobes; its flower-stem also rises from the root, and is garnished with smaller compound leaves of the same form; its flowers are produced in ramose spikes from the top of the stalk, have a pure white colour, and bloom from April till June; and its berries are about the size of peas, have a shining black colour, and ripen about Michaelmas, and have fetid, nauseous, and dangerous properties.—Two other species, and two or more varieties of these, are natives of North America, and have long been known in Great Britain, and are not unworthy of attention in ornamental culture. The root of one of these species is, or was, greatly used in many disorders by the medical men of North America, and has the reputation of being an antidote to the poisonous bite of the rattle-snake.

BANGLE-EARS. A deformed position in the ears of the horse. The deformity can be rectified, but not without much pain to the animal.

BANK. See **EMBANKMENT**.

BANKRUPTCY. A term which, in its more general and extended sense, may be defined insolvency, actual or presumed, followed by some open and public act denoting that the insolvency is irretrievable. He is a bankrupt, who, being insolvent, has subjected himself to the operation of the bankrupt laws.

In the early ages of a state, the law of bankruptcy is uniformly cruel and oppressive. The unfortunate debtor is regarded as a criminal, without distinguishing whether his inability has arisen from culpability or from misfortune; and the law looks merely to the interest of the creditor, without paying any regard to the feelings or to the future comfort of the debtor. The severity of the Roman laws against debtors in the infancy of the republic, and the oppression of creditors, which occasioned so many popular insurrections and so many secessions to the Mons Sacer, are known to every one. As states advance in civil-

ization, and as commerce becomes more extended, less illiberal notions prevail, and the innocent trader, reduced to bankruptcy by misfortune, becomes an object of compassion rather than of severity. Creditors, too, begin to see that it is for the public interest that the funds of the bankrupt should belong to the creditors at large, instead of being left to be scrambled for by the diligence of individuals; and through the frequency of failures which attends the growth of commerce, the principles of the bankrupt-law are examined and matured into a regular system. The great fundamental principle upon which every code of bankrupt-law must rest is, that from the moment of the failure, the funds of the bankrupt become the common property of his creditors at large, and are no longer liable to be disposed of by himself, or to be attached by individual creditors. The perfection of such code must depend upon the manner in which this principle is carried into effect, by the adoption of a simple, economical, and speedy mode of distributing the common fund.

It was not till a very late period that the bankrupt-law of Scotland assumed a systematic form. Scottish juriconsults, indeed, at an early date, adopted from the Roman law the mild remedy of the *cessio bonorum*, by which an honest though insolvent debtor, who was willing to surrender all his effects to his creditors, escaped the hardship of a long imprisonment; and by the statutes 1621, c. 18, and 1696, c. 5, attempts were made to prevent insolvent debtors from granting any deeds in fraud of their creditors. By this last statute, bankruptcy was accurately defined, and its date being fixed, a presumption of law was established against all deeds granted within 60 days of it, in favour of prior creditors. Still, however, no plan was devised for a general distribution of the bankrupt's effects. The creditors were left to proceed with their individual diligence as they best could, and the maxim of law being, "*Jus civile vigilantibus scriptum est*," an unfortunate debtor was, on the first suspicion of insolvency, overpowered with a torrent of diligence which even the best credit could scarcely withstand.

By the statute 1696, c. 5, any person may be rendered a bankrupt who is at the time in Scotland, and subject to its laws. The effect of this bankruptcy against persons who are not traders, is only such as to enable creditors to challenge undue preferences, and to follow forth the ordinary processes for attachment and distribution of the funds. But by the 33^o Geo. III. c. 74, a new process called *sequestration* was introduced, by which the whole estate of a bankrupt trader is adjudged from him, and vested in a trustee for the creditors at large. The statute describes the persons liable to bankruptcy by sequestration, to be "in general, any person who, either for himself, or as agent or factor for others, seeks his living by buying and selling, or by the workman-

ship of goods or commodities." The ruling statute in cases of bankruptcy was, until lately, the 54th Geo. III., c. 137. Various alterations had been suggested in this act, which expired in 1822, but was repeatedly renewed in consequence of the difficulty of introducing new enactments. A new act for regulating the sequestration of bankrupt estates in Scotland was at last matured, viz., the 2nd and 3rd Victoria, c. 41, which passed August 17th, 1839. All persons capable of entering into trade, are liable to sequestration; peers and others having privilege of parliament; unmarried women and widows coming under the description, and also married women who carry on trade or merchandise independent of their husbands. Trading companies may also be sequestrated; and any debtor "who is or has been a merchant, trader, manufacturer, banker, broker, warehouseman, wharfinger, underwriter, artificer, packer, builder, carpenter, shipwright, inn-keeper, hotel-keeper, stable-keeper, coach-contractor, cattle-dealer, grain-dealer, coal-dealer, fish-dealer, lime-burner, printer, dyer, bleacher, fuller, calenderer, and generally any debtor who seeks or has sought his living, or a material part thereof, for himself, or in partnership with another, or as an agent or factor for others, by using the trade of merchandise, by way of bar gains, exchange, barter, commission, or consignment, or by buying and selling, or by buying and letting for hire, or by the workmanship or manufacture of goods or commodities." A foreigner who has traded to Scotland, or a Scotsman domiciled abroad, cannot be sequestrated although found in Scotland.

Such are the persons liable to sequestration. It is next to be considered, from what acts bankruptcy is inferred, so as to authorize this process. Where the debtor himself concurs, no proof of bankruptcy is necessary. Where he does not concur, the creditor must show that certain steps of diligence have been taken against him. These are, That the debtor shall be under diligence by horning and caption for debt, and shall either, in virtue thereof, be imprisoned, or retire to a sanctuary, or fly or abscond for his personal safety, or defend his person by force; or being out of Scotland, and not liable to be imprisoned, by reason of privilege or personal protection, shall be under diligence by charge of horning, attended with arrestment not loosed, or poinding of any part of his moveables, or decree of adjudication of any part of his estate, for payment or security of debt at the instance of any creditor.

When a person comes under the description of the statute, and has been rendered bankrupt by the use of any of the diligence just mentioned, any one creditor, to the amount of £50, or two creditors to the amount of £70, or three or more to the amount of £100, either with or without the concurrence of the bankrupt, may apply by summary petition to the Court of Session for a sequestration. Where the bankrupt concurs, se-

questration is immediately awarded; where he does not concur, a warrant is granted for serving the petition upon him, and if he does not appear, and show cause to the contrary, sequestration is awarded against him. The court at the same time appoints the creditors to meet and choose an interim-factor for managing the estate, and also appoints a subsequent meeting for choosing a trustee, and, under the recent act, remits to the sheriff of the county within which the bankrupt resides to pursue the routine business connected with the sequestration. Notice of the sequestration must be given, within four days from its being awarded, in the Edinburgh Gazette, and also, within eight days, in the London Gazette. When the factor is chosen, he has power to take possession of the whole estate, books, and vouchers of the bankrupt, who is bound to grant powers of attorney, for recovering any effects he may have abroad. At the next meeting ordered by the court—which must be within six weeks, and not less than four of the first deliverance on the petition for sequestration—the creditors who have produced their grounds of debt, and affidavits to the verity, proceed to elect a trustee, to whom the estate may be assigned for the general behoof. This trustee is to be chosen by a majority of the creditors in number and value. Two trustees may be chosen to act, the one failing the other, but one only can act at the same time. At this meeting, the bankrupt must exhibit a state of his affairs, and the interim-factor must also produce an account of his management.

The trustee must find security to the creditors for his faithful management; after which the Court of Session, upon application, will confirm his nomination, and he is then authorized to take possession of and uplift the estate of the bankrupt, and to exoner the interim-factor. The court at the same time appoints the bankrupt to grant a regular conveyance of his whole estate, to the trustee, under the pain of fraudulent bankruptcy, and failing his doing so, the court may commit him to prison. Whether such conveyance be granted or not, the whole estate is adjudged by the court to be vested in the trustee for behoof of the creditors. The trustee must, within eight days of his appointment, apply to the sheriff to fix two days for the examination of the bankrupt, upon all matters relating to his affairs. The bankrupt's wife, and others of his family, and any other person connected with his affairs, may also be examined. At the last of these examinations, the bankrupt must take an oath that he has exhibited a full state of his affairs; and failing his doing so, he shall be guilty of the crime of fraudulent bankruptcy, and punished accordingly, and rendered infamous. The trustee may apply to the court to grant protections to the bankrupt from diligence, to enable him to attend examinations, and to assist in recovering his estate; and while so employed, the creditors may give him an allowance

for his support, not exceeding three guineas a week. At the meeting at which the trustee is elected, three commissioners are to be chosen to audit his accounts, to fix the commission to which he shall be entitled, and to advise and concur with him in compromises and submissions as to the bankrupt's estate. These commissioners are not entitled to purchase any part of the bankrupt estate.

It is the duty of the trustee to recover and convert into cash, as soon as possible, the estate of the bankrupt, which shall be a fund of division among those who were creditors prior to the sequestration. All preferences or conveyances in security of prior debts, which have been granted by the bankrupt to prior creditors within sixty days of the application for sequestration, are presumed to have been fraudulent, and are liable to be reduced; and all arrestments and poindings used by individual creditors, within the same period, are void, and give no preference, except that the *bona fide* arrester or poinder is entitled to retain his expenses of diligence, and ten per cent. more on the price or appraised value. All *bona fide* transactions with the bankrupt in the buying and selling of goods, and paying or receiving of money, previous to the sequestration, are safe from challenge.

The trustee must keep regular accounts, and lodge the money recovered in a bank; and where sufficient funds are realized, the first dividend is payable on the first day after the expiration of eight months from the date of the first deliverance, and after due advertisement, a dividend shall be paid to those creditors who have produced their grounds of debt and affidavits. When the term of payment of any debt is not arrived a proportional discount shall be made, and the debt ranked accordingly. Where a debt is contingent, a dividend corresponding to the debt shall be set aside and deposited in the bank until the contingency be declared. At the end of twelve months, a second dividend shall be made; and, in like manner, dividends at the end of every four months, till the whole funds be divided. But at the expiry of a year and a half from the sequestration, four-fifths of the creditors may order the whole outstanding debts, &c., belonging to the estate to be sold, for the purpose of making a final division.

After the second dividend, the bankrupt, with concurrence of the trustee and four-fifths of the creditors in number and value, may apply to the court, who are authorized to grant him a final discharge of all debts contracted prior to the sequestration, if cause be not shown to the contrary.

As it is sometimes for the advantage of all parties to settle by composition, the statute declares, that the bankrupt may, at the meeting after his second examination, offer to settle by composition; and if this offer is approved of by nine-tenths in value of the creditors present, another

meeting shall be called to consider of it; and if at this second meeting nine-tenths of the creditors approve of the offer, a report of the proceedings shall be laid before the court; and if it shall appear that the offer is reasonable, and has been assented to by a majority in number and nine-tenths in value of the whole creditors assembled, the proceedings in the sequestration shall cease, and the court shall declare the trustee exonerated, and the bankrupt discharged, except as to the payment of the composition.

Such are the general outlines of the law of bankruptcy in Scotland. It resembles that of England in some of its general features, though there is a strong and marked distinction betwixt the two systems in many particulars.

In England traders only, as defined by the statute 6^o George IV. c. 16, can be made bankrupt. The effects of every other description of persons are left to the remedies of common law, and to be attached and carried off by the diligence of individual creditors, but by 7^o and 8^o Vict., c. 70, a person not coming within the operation of the bankrupt acts, may present a petition to the Court-of-bankruptcy, and, on compliance with the terms of the act, may effect a composition with his creditors, and obtain protection from arrest.

Certain acts are defined by the statute 6^o Geo. IV., c. 16, as marks of bankruptcy. The act enacts, that if any trader shall depart this realm, that is with a view to defraud his creditors, of which intention a jury must decide; or being out of this realm shall remain abroad, the word *realm* here meaning simply the jurisdiction of the English courts; or "shall depart from his dwelling-house, or otherwise absent himself, or begin to keep his house," that is to deny himself to his creditors, or "suffer himself to be arrested, or his goods, money, or chattels, to be attached or sequestrated, or taken in execution, or make any fraudulent grant or conveyance of any of his lands, tenements, goods, or chattels," or make any fraudulent surrender or gift thereof, every such trader so doing, "with intent to defeat or delay his creditors," shall be deemed thereby to have committed an act of bankruptcy. The 5^o and 6^o Vict., c. 122, added to the list of persons who may be made bankrupt. With regard to arrest, however, it is to be observed that the presumption of insolvency will only arise from it if the party remain in prison 21 days without being able to promise bail. The commission of any one of these acts invalidates all the debtor's future transactions, and—until the 1^o & 2^o Will. IV., c. 56—entitled a creditor, to a certain extent, to apply for a commission of bankruptcy, which was immediately granted, of course, by the Lord-chancellor vesting the bankrupt's estate in certain commissioners, who were empowered to lock up his shop, and to order his person into custody to undergo the necessary examinations. As this commission was granted

without the knowledge of the bankrupt, and meant to come suddenly upon him, certain precautions were used to prevent its being maliciously sued out. The act 1° & 2° Will. IV., c. 56, abolished commissions, and substituted *fiats* of bankruptcy in their place. These *fiats* were issued by the Lord-chancellor, the Master-of-the-rolls, the Vice-chancellor, or a Master-in-chancery, upon the petition of any one creditor whose debt amounted to £100; or of two creditors, not being partners, whose debts amounted to £150; or of three or more creditors whose debts amounted to £200. The fiat authorizes the petitioning creditor, or creditors, to prosecute his claims in the Court-of-bankruptcy, or before the commissioners of bankruptcy resident in the country. By 5° and 6° Vict., c. 122, the Privy-council is empowered to establish district-courts of bankruptcy, with two commissioners to each court, two registrars, and from two to four official-assignees; and such courts have been established at Birmingham, Bristol, Exeter, Leeds, Liverpool, Manchester, and Newcastle. By this last act, the debt of a petitioning creditor need not exceed £50; or of two, £70; and three creditors whose joint debts amount to £100 may petition.

The commissioners take proof of the bankruptcy, and of the debtor's being a trader. The trader adjudged a bankrupt is allowed five days notice before the adjudication is advertised; but if he cannot show cause against it, the commissioners appoint two meetings to be advertised. At these meetings the debts are proved; and at the first of them assignees are chosen, in whom the estate is vested for behoof of the creditors.

The whole estate of the bankrupt is vested in the assignees, as it stood in his person when the first act of bankruptcy was committed. After that date, therefore, all his transactions are void and null. It is, however, provided by Sir Samuel Romilly's bill, 46° Geo. III., c. 135, that all conveyances, all payments by and to, and all contracts and dealings by and with a bankrupt, made more than two calendar months before the date of the commission, shall be valid, notwithstanding any prior act of bankruptcy, if the person so dealing had not at the time any notice of such prior act. It was provided by 19° Geo. II. c. 32, that no money paid by a bankrupt to a *bona fide* real creditor in the course of trade, even after an act of bankruptcy, should be liable to be refunded. A bankrupt who conceals goods to the value of £10 is guilty of felony, and liable to transportation for life.

When the assignees have recovered all they can, they must after four, or within twelve months, give notice of a meeting for a dividend. The commissioners then direct the dividend to be issued at so much a pound.

Within eighteen months from issuing the commission, a second and final dividend is ordered, if there be any thing remaining; and if there be a

surplus after all the debts are paid, it belongs to the bankrupt.

By the 6° George IV., c. 16, if the bankrupt conformed in all respects to the statutes, and if the creditors, or four-fifths of them in number and value, signed a certificate to that purport, the commissioners were to authenticate the same, and transmit it to the Lord-chancellor, who, upon oath made by the bankrupt, that it was obtained without fraud, might allow the same, or disallow it on cause shown by any creditor. If it was allowed, the bankrupt was entitled to an allowance out of his effects to put him in a way of industry. This allowance was proportioned to the amount of the dividend on his estate, but might never exceed £300. The bankrupt was also, by his certificate, discharged for ever from all claims for any debts which were proved or proveable under the commission. By the 5° and 6° Vict., c. 122, the court acting in the prosecution of any fiat in bankruptcy dispenses with the signatures of creditors, but holds a public sitting, of which due notice is given in the London Gazette; and at such sitting will hear any creditors against the certificate being allowed, but will judge for itself of the validity of their objections.

Such is the law of England regarding traders. All other persons remain subject to the common law, both as to their person and effects. They are liable to perpetual imprisonment, unless relieved by the insolvent acts occasionally past, or by the provisions of what is called the Lords' act. By this statute it is provided, that a debtor incarcerated for a debt under £300, may petition the courts for liberation, which will be granted on conveying to his creditors all his effects. Had the enactment ended here, it would indeed have been a most salutary provision, equal in kind, though not in extent, to the Scotch process of *cessio bonorum*; but it goes on to declare, that if the incarcerating creditor shall object to the liberation, and shall find security for an aliment to the debtor, not exceeding two shillings and fourpence weekly, he may detain him in prison. See *Bell's Commentaries on the Law of Scotland in relation to Bankruptcy*.—*Cooke and Cullen's Treatise on the Bankrupt Law of England*.—*Burton on the Law of Bankruptcy, Insolvency, and Mercantile Sequestration in Scotland*.

BANKSIA. A genus of evergreen, ornamental, Australian shrubs and small trees, of the protea tribe. They are named in compliment to Sir Joseph Banks; they give a striking feature to the landscape in their native country; and they are much admired in the conservatories of Europe for their fine outline, their handsome foliage, and their remarkable and imposing heads of flowers. Five species were introduced to Britain in 1788; nearly forty species have been introduced since that time; and probably a considerable number more may yet be discovered. They occur on rocky grounds or on sandy forest land, in all the known parts of continental Australia; but they

abound chiefly in the least torrid parts of that country, and occur in the most fertile tracts of the Swan river colony; and, except in the last of these districts, they are usually regarded as indications of the barrenness of the soil. Their usual name among the Australian colonists is honey-suckle trees; but they possess little to justify it, and have scarcely a property in common with either the woodbine or the azalea. The broad-leaved species has a height of about 30 feet, the saw-leaved, the oblong-leaved, and the taller species have a height of from 15 to 20 feet, and the entire-leaved and the verticillate species have a height of about 12 feet; but nearly all the other species vary in height from 1½ to 6 feet. The leaves of all the species are hard and dry, and, in general, are cut in the edges while the plants are young, and undivided when the plants are old; and they have a dull green colour on their upper side, but are usually white or very pale green on the lower. The flowers are small, narrow, tubular calyxes, closely compacted, sometimes to the number of six hundred or upwards, into oblong, vertically-situated heads; they do not fall when the season of bloom is over, but wither, become brown, and remain attached to the axis of the head; and in the coccinea species they are scarlet, in the sea-shore species orange, in the southern and the rival species green, and in most of the other species yellow. Most of the species are propagated from cuttings, and thrive best in sandy peat or in peat and loam.

BANYAN-TREE,—botanically *Ficus Indica*. A remarkable, evergreen, ornamental Indian tree, of the fig-tree genus. It was introduced to the hot-houses of Great Britain from India in 1759, and usually grows to the height of about 30 feet. In its native woods, fibres descend from the underside of its horizontal branches, grow downward to the earth, take root, increase in bulk, and ultimately become so many stems and props of the tree; and, in this country, in at least one instance, similar shoots, to the number of thirteen, have been coaxed down to rooting condition in the soil by means of rocket-cases, filled with equal parts of white sand and sifted loam.

BAOBAB. See **ADANSONIA**.

BARB. A noble breed of horses, taking its name from Barbary, and reared by the Moors of that country and Morocco. The common horse of Barbary is a very inferior animal, either of different origin from the true barb or exceedingly deteriorated. The barb was introduced by the Moors to Spain; but there also it has greatly degenerated. The true barb of the present day is to be found chiefly among the wild nomadic tribes of the Barbary and Morocco deserts. His chest is long and slender, and rises beautifully from the withers; his mane is small; his head is well-shaped, small, and lean; his shoulders are flat and slender; his withers are narrow and plump; his back is straight and short; his flanks and sides are round and do not belly out; his

haunches are well-shaped and firm; his croup is generally somewhat long; his tail is placed pretty high; his thigh is well-shaped and seldom flat; his legs are well-shaped, handsome, and without long hair at the pastern joint; and his feet are well made, but his pastern is often long. Yet a member of the Jockey Club would pronounce his head large and clumsy, his neck short and thick, and his body and legs so long and slender as to resemble those of the greyhound, and be quite out of symmetry with the normal proportions of the horse. The barb, in fact, is not eminent for either beauty or symmetry; but is altogether unrivalled for speed, lightness, abstinence, endurance, temper, and the impartation of good properties in the improving of a breed. A barb, in its native country, is saddled and mounted at two years of age, and cropped in tail and mane till six years of age; it is never either combed or castrated; and after its sixth year, it is never cropped. The male alone is used for the saddle; and the female is kept merely for the purpose of breeding. The barb has afforded the chief contribution to the excellence of the Spanish horse; and he was early introduced for the improvement of our English breeds. The Godolphine Arabian, from whom some of the best English racing-horses have descended, was a barb; and eight or nine of the most celebrated turf brood-mares of the last century in England were barbs. See article **HORSE**.

BARBACENIA. A beautiful and recently discovered genus of tender evergreen herbaceous plants, of the *hemodorum* tribe. Twelve species are already known to botanists; and the purple species has recently been introduced to our hot-houses from Brazil, grows 1½ foot high, and has carex-like leaves, and lively, purple flowers,—the latter appearing in July.

BARBADOES CEDAR. See **JUNIPER**.

BARBADOES CHERRY,—botanically *Malpighia*. A genus of tropical, evergreen, ornamental and fruit shrubs, forming the type of the natural order malpighiaceæ. This order comprises 13 genera, and has contributed to our hot-houses upwards of 70 species. Most have firm, neat foliage, and showy pink or yellow flowers; and many are remarkable for stinging bristles or prurient hairs, resembling cowitch. Their timber has a dark red colour; and their bark has been used in medicine as a febrifuge. About a dozen species of the Barbadoes cherry genus are cultivated in our hot-houses; and seven or eight more are known to botanists. The fruit of one of the species is extensively eaten in the West Indies as a succedaneum for cherries; yet though possessing a pleasant subacid flavour, is but of indifferent nature. All the introduced species have long been valued for the fine appearance which their flowers make during most of the dullest portion of the year, from December till the end of March. They are propagated from seeds or cuttings in peat and loam.

BARBADOES GOOSEBERRY, — botanically *Pereskia*. A genus of West Indian and South American cacti, of the opuntia division. Four species, all ranking as evergreen fruiting shrubs, have been introduced to British conservatories; and two of these were included in the old genus cactus. The species longest and most generally known is called gooseberry in America and bladder-apple by the Dutch; it has many slender branches, which must be supported on stakes or will trail on any plants in their vicinity; it has tufts of long whitish spines over both stem and branches; its leaves are roundish, and very thick and succulent; and its fruit is about the size of a walnut, containing a white mucilaginous pulp, and having on its exterior tufts of small leaves. All the species are propagated from cuttings in sandy peat. See the article CACTUS.

BARBADOES LILY. A species of *AMARYLLIS*: which see.

BARBAREA. See WINTER CRESS.

BARBELS or **BARBS**. Inflamed knots or excrescences of flesh, in the mouth of the horse or the cow. They are formed sometimes during catarrh, and more frequently during any inflamed condition of the mouth; and they usually accumulate under the tongue, and may be fully seen by drawing it aside. The method of cure recommended in old works on farriery, and still practised by most cattle doctors, is to cut or burn them away; but this both inflicts very unnecessary pain upon the animal, and incurs a serious danger of converting the barbels into severe and even gangrenous ulcers. A mere cathartic and a little patience may be sufficient; or if any tendency to ulceration should appear, an alum wash will be enough. Should any abscess be formed in consequence of bad treatment, first chloride of lime and afterwards an alum wash or an infusion of catechu may be applied.

BARBERRY, or **PIPPERIDGE-BUSH**, — botanically *Berberis*. A genus of ornamental and fruit shrubs, forming the type of the natural order berberideæ. This order comprises 7 genera; but its principal interest is concentrated in the old genus *berberis*, comprising the present genus *mahonia*. Most of the other genera consist of low, uninteresting herbaceous plants; yet *nandina*, which is one of them, consists of a single species of elegant Japanese shrubs. About twenty species of the genus *berberis*, exclusive of varieties, are cultivated in the gardens of Great Britain; and many remarkably fine species in Chili and India have not yet been introduced. All the species possess both beauty and general interest; and the pinnate-leaved sort, now called *Mahonia*, are particularly elegant. See MAHONIA. The sweet-fruited species, the Canadian species, and all the varieties of the common species are fruit shrubs; the emarginate, the holly-leaved, the various leaved, the Asiatic, the awned, Wallich's, the ruscus-leaved, the whitened leaved, the meek, and the twiggy species are evergreen shrubs; the

box-leaved, the empetrum-leaved, and the unarmed species are evergreen undershrubs; and the common, the hawthorn-leaved, the Iberian, the Provence, the Daurian, the Chinese, the Cretan, and the many-flowered species are deciduous shrubs. The common species and two or three others grow to the height of about 8 feet; but most range between 2 and 6 feet. All carry yellow flowers; and most bloom in April and May. An astringent property resides in the bark and stem of most of the genus; and both astringency and acidity reside in the berries of nearly all.

The common barberry, *Berberis vulgaris*, grows naturally in the hedges of England, and in most other parts of Europe, but is cultivated in gardens for its fruit. It prefers light and chalky soils, and often grows to the height of from 8 to 10 feet. Many stems rise from one root; their bark is white on the outside and yellow on the inside; sharp thorns, usually growing in threes, arm both the stems and the branches; the leaves are oval, obtuse, and slightly serrated; the flowers are produced, in small bundles, from the wings of the leaves, like those of the currant bush; and the fruit is oval, and at first green, but afterwards a fine red. Six well established varieties, all cultivated and valued for their fruit, are now to be met with in the nurseries, and are designated *violacea*, *alba*, *lutea*, *purpurea*, *nigra*, *asperma*, and *dulcis*, or violet-fruited, white-fruited, yellow-fruited, purple-fruited, black-fruited, seedless, and sweet-fruited. Only the first and the second of these varieties, however, are indigenous, the others having been imported from the continent of Europe. The white-fruited variety has whiter bark and lighter green leaves than the normal variety, but it seldom bears fruit. The seedless variety was long supposed by the most eminent horticulturists to be only accidental in very old plants; but it is now ascertained to be strictly permanent, and to maintain its characteristic in young and healthy plants on the most favourable soil; and it is sometimes designated the maiden barberry. The other varieties are distinguished chiefly by the peculiar colour or flavour of their fruit. All the varieties may be propagated from either suckers or layers. Plants raised from suckers are subject to a profuse and annoying growth of new suckers, and are less desirable than plants raised from layers. Young shoots of one season should be layered at the falling of the leaf in autumn; and the plants from them ought, exactly a twelvemonth after, to be removed to their final situation. The plants, when cultivated for fruit, ought to be placed singly, not in hedges; and all their suckers and their gross shoots should be pruned out every autumn. The Canadian species, which is also cultivated for its fruit, was formerly in more reputation than at present: its leaves are much broader and shorter than those of the common species; and its fruit, when ripe, is black. The Chinese and the emarginate spe-

cies are best propagated by grafting; but all the other species are propagated in the same method of layering as the common species.

The barberry has long—though most eminent phytologists think it has unjustly—had the bad fame of exerting a poisonous influence upon corn, particularly upon wheat. "This," says Marshall, "is a circumstance which has been long known to the common farmers in different parts of the kingdom, especially in Norfolk, where the farmers are more observant and much more enlightened than those useful members of society generally are. The idea, nevertheless, has been treated by theoretical writers on husbandry as chimerical and superstitious, and has been brought forward as one of those vulgar errors of farmers which ought to induce gentlemen and men of genius to rescue so useful a science as that of agriculture out of the hands of ignorance. Being, however, always ready to hear the opinion of professional men, and having been assured by many sensible farmers of the truth of this matter, we had a few years ago a barberry bush planted, in the month of February, in the centre of a large piece of wheat. No obvious effect took place until the corn began to change its colour before harvest, when a long blackening stripe became so conspicuous amongst the growing whiteness of the wheat, that it might have been distinguished at a mile's distance. It resembled the tail of a comet, the bush representing the comet itself; and what rendered the experiment striking, whilst on one side the effect did not reach more than three or four feet, on the opposite side it was obvious to the distance of ten or twelve yards, notwithstanding the top of the shrub planted was not much larger than the head. At harvest, the ears of wheat which grew in the immediate neighbourhood of the bush, stood erect, the grains shrivelled and empty; as the distance from the barberry increased, the effect lessened, vanishing imperceptibly; whilst the grain of the rest of the field was of a good quality." The Rev. Dr. Singer, the author of the *Agricultural Report of Dumfries-shire*, in a short paper among the published *Transactions of the Highland Society*, states an apparently strong fact or two respecting the devastations of rust or mildew on corn-crops, and the identification of the cause of it with the influence of the barberry. "On one farm alone," says he, "that of Kirkbank, on the estate of Annandale, Mr. John Aitken, the respectable tenant, lost about £100 in his oat crops yearly; and altogether the damage in this county was, without doubt, considerably above £1,000 yearly. The views of Sir Joseph Banks, and of some intelligent practical farmers, relative to the evil influence of the *Berberis vulgaris*, induced the late Admiral Sir William Johnstone Hope to give orders for the total extirpation of the barberry bushes which grew intermixed with thorns in the hedge-rows; and since that was done, and above twenty years, no such distemper has

appeared in these fields. The same thing has been done in some parts of Ayrshire, and the same result has followed." The same unsparing extirpation of the barberry from hedges, though far from being in every case followed by any observable good effects, has been general or almost universal throughout England.

Yet, even in the face of these seemingly strong facts, we are not at all disposed to concur in the accusation against the barberry. Mere theory, indeed, even though vindicated by the scientific observations of such distinguished phytologists as Duhamel, Broussonet, and others, would not induce us to resist a general and well-concocted testimony by farmers. But practical agriculturists themselves are far from being unanimous in denouncing the barberry, and many of them concur with experimental phytologists of the highest credit in declaring it perfectly innocuous. L. A. Staudinger, an experienced and enlightened cultivator at Flotbeck, near Hamburg, made observations on mildew and ergot between the years 1799 and 1830, and, in a published report of them, has completely exonerated the barberry. Horne-mann planted wheat and surrounded it with barberry bushes in the botanic garden of Copenhagen; yet, though he repeated the experiment several times, he did not obtain any mildew. Jussieu conducted a similar experiment with the same result, in the garden of Trianon. Mr. Knight also conducted a similar experiment, enjoyed an opportunity of seeing the wheat mildewed during the course of his experiment, and ascertained, by careful examination, and by a series of comparative trials, that the barberry was not to be blamed for the mildew. The Rev. Mr. Henslow, professor of botany in Cambridge, likewise had opportunity of instituting examination of mildew in the vicinity of the barberry, and ascertained that it might with as much plausibility be ascribed to the shade of trees or the wetness of the soil as to the influence of this plant. "To those," says Professor Henslow, "who feel as interested as myself in having this question settled beyond dispute, and who may possess the opportunity for doing so, I would suggest the following experiment. Let barberry bushes be planted in the middle of some fields, and protected by fences; let it be observed whether the corn grown in those fields is mildewed, and the circumstances under which this happens accurately noted; let all failures be equally recorded. If the results of these experiments should tell to the prejudice of the barberry, I would willingly travel many miles to be convinced, by personal inspection, that this pretty and botanically interesting shrub had really caused the evil imputed to it." The barberry is subject to attack from a minute parasitic fungus called *Æcidium berberidis*, and wheat is subject to attack from a quite different minute parasitic fungus called *Puccinia graminis*; and the general accusation against the barberry seems to have mainly, if not even wholly, arisen from

the confounding of these fungi. See the articles *ÆCIDIUM*, *PUCCINIA*, and *MILDEW*.

The marmalade of barberries has the reputation of being, not only an agreeable condiment, but an excellent diuretic, and a cleanser of the stomach. The French call barberries and spinach the besoms of the stomach, *les balais de l'estomac*. To make marmalade of barberries, wash and stone any quantity of the berries; boil them, with a quarter of a pint of water to each stone of the berries, in a clean and newly-tinned stewpan, till they are reduced to a mash; boil the mash till it acquires the thickness of a paste; mix with this paste a well clarified syrup, prepared in the proportion of $1\frac{1}{2}$ pound of sugar and a pint of water to each pound of the berries; heat and stir the mixture up to a temperature immediately short of the boiling-point; and finally decant the preparation into preserve-pots. Pickled barberries are prepared with a pickle in the proportions of a gallon of vinegar, four ounces of common salt, an ounce of powdered ginger, a little sliced horse-radish, a pound of refined sugar, and a pint of barberry juice boiled with a little salt and water. Inferior berries are used for making the barberry juice; and the best bunches of the best berries are used as the berries to be pickled. The root of the barberry contains about 17.6 per cent. of the yellow colouring matter called *berberin*, which is employed in staining Morocco leather.—*Miller's Dictionary*.—*Quarterly Journal of Agriculture*.—*Transactions of the Highland Society*.—*Journal of the Royal Agricultural Society of England*.—*Marshall's Rural Economy of the Midland Counties*.—*Marshall's Rural Economy of Norfolk*.—*The Farmer's Magazine*.

BARBS. See **BARBELS**.

BARDANA. The woolly-headed burdock. It belongs to the thistle division of the composite tribe of plants, and was formerly called by botanists *Bardana tomentosum*, but is now included in the genus *arctium*. It is a biennial weed of the waste grounds of Britain, grows to the height of 3 feet, and produces a purple flower in July and August.

BARILLA. A mixed salt of soda, well known in commerce, and extensively used in the manufacture of soap and glass. It is principally prepared by lixiviating the ashes of the plants *Salsola soda* and *Salicornia herbacea*; and these plants are extensively cultivated for the preparation of it in the Spanish provinces of Valencia and Murcia. The purest barilla, though chiefly consisting of carbonate of soda, and though well fitted for the manufacturing processes in which it is employed, always contains some proportion of sulphate of soda, sulphate of potash, chloride of sodium, and chloride of potash. The part which barilla might play in the practical applications of agricultural chemistry, is amply indicated by our articles on **ALKALIES** and **ASHES**. In 1842, the quantity of barilla and alkali imported into the United Kingdom amounted to 43,300 cwts., whereof nearly

one-half was from Spain and the Balearic islands.

BARK. The external coating of the stem, branches, and roots of plants. In endogenous or monocotyledonous plants, it is so persistent with the central portion of the stem that it cannot be separated except by a violent rupture of its own fabric and a laceration of the tissue immediately below it; but in exogenous herbaceous plants, it can always be separated by careful manipulation; and in exogenous woody plants, it every spring spontaneously separates its whole sheath from the enclosed wood of the previous year, and eventually accumulates excrementitious layers or plate-like masses of dead matter on its own exterior. Endogens achieve their growth solely by enlargements and elongations of the central portion of their stems, and hence their bark never shifts its position, and can experience no other change in relation to the rest of the organism than mere increase of quantity; but ligneous exogens achieve their growth by annual deposits of woody matter on the exterior of their duramen and annual deposits of cortical matter in the interior of their sheath, and hence their bark is organically forced to undergo an annual change of its position, and chemically subjected to an eventual constitutional change of its exterior portion, both by the outward pressure of the new deposits of wood and the intrinsic enlargement of its own accessions of substance.

Exogenous bark, such as that of all the hardy trees and shrubs of our climate, consists, as to its sound or living portions, of three distinct parts,—first, the liber or inner bark, which is situated next the wood,—second, the cellular tissue or parenchyma, which has a fine green colour in the bark of the stem and branches, but is colourless in the bark of the root,—and, third, the epidermis or outer bark, which constitutes the skin or really exterior covering of the whole plant. The liber of the first year consists of a layer of cellular matter and a layer of woody matter, jointly constituting an annual cortical deposit; and the liber of future years consists of the aggregate number of cortical deposits, precisely corresponding to the number of concentric deposits of enclosed wood. Were not the formation of the bark affected by a disturbing force, the successive layers of the liber would be as regularly arranged and as strictly concentric as the successive layers of the wood; but in consequence of the strong and incessant lateral strain exerted upon it by the wood's perpetual increase in diameter, it soon loses all trace of regularity, and becomes a confused mass of cellular tissue and woody tubes. Yet the liber of some old plants can easily be peeled into layer after layer, and, in some rare instances, has been peeled into so many as one hundred and fifty layers; though its capability of being thus mechanically separated into layers is probably occasioned less by the depositional mode of its formation, than by



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the relative arrangement of the ultimate vesicles of which it is composed. "In aged trunks," says Keith, "the outer layers are coarse and loose in their texture, exhibiting individually a considerably indurated, but very irregular network, composed of bundles of longitudinal fibres, not ascending the stem directly, but winding more or less around the axis of the plant. As the layers recede from the circumference, the network which they form is finer, though still very irregular, and their texture more compact. Yet the meshes of the several layers often correspond, and form, at least in aged trunks, pyramidal apertures, or widen into large gaps or chinks, as in the trunk of the oak or elm, exhibiting still the rough traces of the original network. In young trees or shoots, the apertures formed by the coincidence of the meshes are not yet left empty, but are occupied by a pulp somewhat compressed, which traverses the longitudinal fibres, and binds and cements them together." The liber, however, according to the use of the word by some phytologists, comprises only the innermost layer of a plant of any age, and, in the same manner as the alburnum, exists during only one year, or till thrust out of its position by the next annual deposit; and this innermost layer, whether permitted to monopolize the name of liber or not, is always the finest and most delicate of the cortical layers, soft, smooth, flexible, capable of being reduced or subdivided into an absolute film, and often though not always exhibiting the most beautiful reticulation.

The parenchyma consists of hexagonal cells containing a green-coloured juice in the branches and main body of the stem, and a colourless juice in the root and the portion of the stem beneath the surface of the soil; and even when the parenchyma is covered by a thick and indurated epidermis, the greenness of it in the parts above ground exists, and may easily be seen in any spot by the removal of a small portion of the epidermis. *Plate VI. Fig. 1*, exhibits the regular structure of the parenchyma or cellular substance, as seen under a powerful microscope. A transverse section of the hexagonal cells is seen in *a*; a vertical section of the same in *b*. That the sides of the cells are common to those that are adjacent, appears from *c*. In *Fig. 2* a portion of cellular substance, with more porous membranes, and more elongated cells, is shown. *Fig. 3* is an example of lengthened cells, pierced by pores in regular order. *Fig. 4* is another specimen of cellular substance containing fissures as well as pores. In the early period of vegetable life, the cellular network forms a number of lacunæ, which, when matured, become a series of vessels, which in monocotyledonous plants are always found in the middle of woody fibres, or compose the greater part of them; while in dicotyledonous plants, they appear to be disposed at random throughout the wood. Mirbel describes four kinds of these tubes: viz., 1st, The simple or con-

tinuous tubes, which commonly contain those resinous and oily juices which are known as the 'proper juices' of a plant. This class of pores is very distinct in the Euphorbiæ. They are shown in *Fig. 5, Plate VI. 2d*, The porous tube, the coats of which are penetrated by small holes in regular series. It is found chiefly in hard woods. See *Fig. 6. 3d*, The false air-vessels, which are tubes transversely cut by parallel fissures. See *Fig. 7*. They are numerous in the vine. 4th, Air-vessels, chiefly found around the pith, and formed by the turnings of fibres from right to left. *Fig. 8* represents true spiral air-vessels of different sizes; *Fig. 9*, a large tube, with some of the spiral turns untwisted. *Fig. 10* represents the whole of these organs united.

On young shoots and stems, the epidermis appears as if it were a thin transparent membrane without any vascular formation, yet, when examined through very powerful glasses, it is seen to possess minute retiform vessels. *Fig. 11*, in *Plate VI.*, represents a portion of imperforate cuticle; *Fig. 12*, a portion with elongated pores. In *Fig. 13* a portion of 'velvety cuticle' is represented, in which the magnified elevated points are merely an external elongation of the surface of the cellular membranes, or a kind of protrusion formed by that substance. Both the parenchyma and the epidermis, however, belong rather to the young and soft parts of a plant than to the stems and older branches of trees and shrubs; and whenever ligneous plants pass the period of youth, the bark of their stem loses all parenchyma and epidermis, and begins to convert even the outer layers of the liber into dead matter, and to commence a constant series of effort to throw them away. The thin transparent skin which constitutes the epidermis is ruptured, and never afterwards renewed; the green matter of the parenchyma, after exposure to the air, becomes brown, and loses its vitality; the outermost layers of the liber harden, die, and crack; an exterior, many-shaped, and even amorphous coating of dead or excrementitious matter is formed; and a constant struggle of the enclosed living plant goes on to free itself of this dead matter, either by the exfoliation of layer after layer as in the case of the birch, or by the rejection of considerable plates or nodules as in the case of the plane-tree and the pine.—In such monocotyledonous plants as are strictly endogenous, or effect their growth by simple enlargement of the centre of their stems, the bark undergoes no other change, from infancy to old age, than to lose its green colour, and become more fibrous; and in such monocotyledonous plants as are acrogenous, or effect their growth principally by elongation of their centre, it undergoes no other change than to become more compact or indurated.

The bark protects the enclosed wood and its own innermost layers from the effects of inclemency and vicissitude in the weather; and there-

fore has either a thicker or otherwise a more protective structure in exogens than in endogens, in trees of the temperate zone than in those of the tropics, and in trees of alpine or other very cold districts than in those of moderately warm plains.—Exogenous bark serves also the grand purpose of conveying down for secretion, in its own layers, in the wood, and in the roots, certain fluids which have been elaborated by the leaves out of the ascending sap of the plant and the gases of the atmosphere. It is penetrated by the medullary rays as fully as the wood, and is connected with them by myriads of points throughout its interior, and, in consequence, possesses countless and pervading lateral or horizontal communications between its own exterior and the very pith of the stem; the cellular and reticulated confirmation of its living liber affords a ready descending percolation, in constant contact with the medullary processes, of the portions of fluid designed to be conducted through these processes for secretion in the ligneous portions of the stem; its woody tubes permit an easy descent, and assist a facile secretion, of the portion of fluid designed for the formation of such chemical substances as peculiarly impregnate the bark; and its loose texture readily permits and aids the formation and filling of the fistular cysts which are designed to be the stores of resinous secretions. Yet the chief volume of descending fluid in a tree, or that which is assimilated into the new alburnum of the wood and the new liber of the bark, must be viewed in a different light, and will be noticed, at its alphabetical place, under its proper name of CAMBIUM.—In succulent plants, such as stapelias and cacti, where no proper leaves exist, the bark appears to effect the processes of exhalation, inhalation, and elaboration of sap with gases, which in other plants are effected by the leaves. See the article LEAF.

In consequence partly of the outer or dead portion of old exogenous bark being excrementitious, and partly of the inner or living portion being the seat of the secretion of cortical juices and the medium of the conveyance of some juices of the woody secretions, it very widely differs from the wood in chemical composition, sometimes containing substances of which the wood is nearly or altogether destitute, and often containing a larger proportion than the wood does of even the latter's peculiar chemical character. The bark of the oak, the larch, and other tanniferous trees contains the peculiar principle which serves the purposes of tanning leather; the bark of the cinchona tree, the cinnamon tree, and many other similar plants, contains their febrifugal and aromatic principles; and the bark of the acacias, the pines, and the many other gum-miferous, balsamiferous, and resin-bearing trees contains all their gum, their balsam, their turpentine, and their rosin. "When," says Liebig, "we compare the barks of the fir, pine, beech, or oak, with their sap and wood, we find that they differ

essentially from each other, both in their composition and characters. True wood yields only one-fourth to two per cent. of ashes, while the bark of the oak, fir, willow, and beech, gives six, ten, to fifteen times more. The ashes of wood and of the bark have a very different composition. The inorganic ingredients of the bark are obviously inorganic substances expelled by the living organism. The same reasoning holds good in the case of the organic substances as it does in the case of the bark. The bark of the cork-tree contains nearly half its weight of fat or of fatty substances, which we also find present, although in smaller proportion, in the bark of firs and pines. The solid material (insoluble in alcohol or ether) of these barks is entirely different from woody fibre. The barks of firs and pines are completely soluble in potash leys, forming a liquid of a dark brown colour, which yields, on the addition of an acid, a precipitate strongly resembling the substance called humic acid. But wood is not attacked by potash ley." The strictly excrementitious nature of the dead portion of bark, appears in at once its exterior and decaying position on the plant, its total destitution of organism, its possession of inorganic substances which the living portions of the plant either totally want or possess in a smaller degree, and its playing no part whatever in either the plant's growth or in any other of its functional processes. The regular organic effort of trees and shrubs to throw off the exterior portions of their bark, either in annual peelings or in occasional masses, is, in the strictest sense, excrementition. Hence the well-known circumstance that all the dead portions of bark, such as the peelings of the birch and the snowberry, the irregular plates of the plane-tree and the pines, and the thick and massive layers of the cork-tree, may be removed without occasioning the slightest injury to the plants. The excrementition, moreover, is far from being confined to the old bark of stems, but may be readily observed in the embrowning of water by the vegetation in it of the smallest living twig, or the growth in it of the radical fibres of a hyacinth or any other bulb, and may be presumed or almost proved to go on in the bark of every portion of a plant from the extremity of every rootlet to the point of every little branch. The whole of the excrementition, quite analogously to that of animals, consists in the rejection of inorganic substances which the vital processes cannot assimilate; and so far as this goes on from the roots or beneath the surface of the soil, it makes deposits and effects chemical changes in the ground, which afford the grand explanation of the well-known phenomena of rotation of crops. See the article EXCRETIONS OF PLANTS.

A wound through the cortical layers of a young plant is healed without a scar; but a wound through those of an old plant is altogether incurable. When a wound in a middle-aged tree is small, the upper lip gradually grows downward

till it comes in contact with the lower lip, and then adhesion follows, and the wound is healed; or when a wound is inflicted in peculiar circumstances, or upon peculiar kinds of trees, granulations form at the mouths of the exposed medullary processes, and gradually extend themselves over the excorticated surface till they become fused into one another, and constitute a covering of bark; or when a wound is so inflicted that communication between the upper and the lower lips is still partially or even slightly maintained, a lateral transfusion of the descending sap takes place, and all the current of it is gradually diverted into the channel or remaining portion of communication till the wound is healed. When partial or total denudation of cortical matter takes place, as in the barking of the oak for tanners and the excortication of the cork-tree for commerce, or in the accidental or mischievous peeling of very large plates from any ordinary forest-tree, either the dead part alone of the bark is removed, and no injury whatever is inflicted, or a sufficient though very thin portion of the liber is left to enable the plant to recover its energies without any serious damage, or the whole of the liber is removed, and the plant, according to its own vigour, to the season of the year, to the presence or the absence of alburnum, or to other modifying circumstances, either speedily dies or maintains a severe and eventually successful struggle for existence. The healing of any severe or doubtful wound is very greatly aided, in trees as in animals, by any appliance which lessens electric action and excludes the atmospheric air. A practical gardener, writing in *Loudon's Magazine*, gives the following recipe for "making the bark grow over wounds and diseased places in forest or fruit trees, without fail and with speed:—When a branch is cut off a tree or otherwise wounded, make the place smooth with a sharp knife; and if the tree be cankered, either cut away the part affected, or scrape it out until you come to the sound wood. In all cases make the surface as smooth as possible; then put half a pound of tallow into two pounds of tar, and warm it over the fire, till the tallow is just melted in the tar; when one ounce of saltpetre should be added, and the whole stirred well together. The composition must then be laid on the parts that you want to heal; and I have found it, by long experience, to be an effectual cure, and superior by far to any thing yet practised."

Tannin, or the peculiar principle which changes hides into leather, abounds most in the white interior layers of oak bark, and has long occasioned that bark to be in great commercial demand for the supply of tan-yards; yet it also exists in sufficient quantity in the barks of various other kinds of trees to be an important ingredient in their value. See the articles *OAK*, *TANNING*, and *BARKING*. The proportion of tannin in the bark of any one species of tree differs according to various circumstances, particularly the season of

the year at which the bark is removed, and the temperature of the period immediately preceding its removal; yet the quantity in each of some of the best known trees, as ascertained by Sir Humphrey Davy, may be regarded as, in nearly all instances, a close approximation, and, at all events, affords a fair comparative view of the tanniniferous value of the different trees. The average relative value of birch-bark in tannin, Sir Humphrey states to be 8; of horse chestnut, 9; of beech, 10; of large common willow, 11; of sycamore, 11; of elm, 13; of hazel, 14; of black thorn, 16; of ash, 16; of Spanish chestnut, 21; of oak cut in autumn, 21; of middle-sized oak cut in spring, 29; of coppice oak, 32; of large Leicester willow, 33; and of the white interior cortical layers of oak, 72. The tannin of the larch is usually a little less than one-half of the tannin of the oak; the tannin of the interior cortical layers of any tree is always very much greater in proportion to the weight than that of the entire bulk of the bark; and the tannin of properly peeled and carefully harvested bark is always in far larger proportion than the tannin of bark which has been peeled under bad conditions, or which has been allowed to ferment in consequence of injudicious harvesting. Mr. Monteath of Stirling, by applying a chemical test to carefully prepared infusions and decoctions of the different kinds of barks, ascertained that tannin exists in greatest quantity in the oak, next in the ash and the hornbeam, next in the Spanish chestnut, next in the green willow, the bay-leaved willow, the common hoop willow, the gray willow, and the Huntingdon willow, next in the birch, the beech, and the larch, next in the spruce and the silver firs, next in the mountain ash and the common broom, next in the laburnum, and variously in the Scottish pine, the bramble, and the sawdust of oak timber; and he says that all these kinds will tan leather, and that the bramble, the dock, and the common broom might be good tanning substitutes for the ordinary tanning barks. Among other tanniniferous substances either now or formerly in use are heath, gall-nuts, myrtle leaves, wild laurel leaves, and wattle bark. The last of these is obtained from two species of mimosa which abound in New South Wales, Van Dieman's Land, and New Zealand; and though only three-fifths of the tannin-strength of the best oak bark, is largely imported for the use of British tanners.—The weight of bark afforded by any tree in proportion to its bulk of timber varies according to the kind of tree, its age, its healthiness, and the conditions under which it grew, whether upon good or bad soil, in a confined or an exposed situation, in free and open ground, or among choking underwood. Mr. Monteath, stating the results of his own observation, that an oak of 40 years of age yields from 9 to 12 lbs. of bark per cubic foot of timber, an oak of from 80 to 100 years of age yields from 10 to 16 lbs. of bark per cubic foot of timber, a

larch from 8 to 10 lbs., a large birch from 11 to 14 lbs., and a willow from 9 to 11 lbs.

Every kind of bark may be proved, by analysis of its ashes, to contain a large proportion of the peculiar inorganic substances which operate as fertilizers of the soil. According to analysis by M. Saussure, the ashes of oak-bark contain 7 per cent. of soluble salts, 3 of earthy phosphates, 66 of earthy carbonates, $1\frac{1}{2}$ of silica, and 2 of metallic oxides; the ashes of hazel-bark contain $12\frac{1}{2}$ per cent. of soluble salts, $5\frac{1}{2}$ of earthy phosphates, 54 of earthy carbonates, $\frac{1}{4}$ of silica, and $1\frac{1}{4}$ of metallic oxides; the ashes of poplar-bark contain 6 per cent. of soluble salts, 5.3 of earthy phosphates, 60 of earthy carbonates, 4 of silica, and $1\frac{1}{2}$ of metallic oxides; the ashes of mulberry-bark contain 7 per cent. of soluble salts, $8\frac{1}{2}$ of earthy phosphates, 45 of earthy carbonates, $15\frac{1}{4}$ of silica, and $1\frac{1}{2}$ of metallic oxides; and the ashes of hornbeam-bark contain $4\frac{1}{2}$ per cent. of soluble salts, $4\frac{1}{2}$ of earthy phosphates, 59 of earthy carbonates, $1\frac{1}{2}$ of silica, and $\frac{1}{4}$ of metallic oxides. According to an analysis recorded by Liebig, the ashes of fir-bark contain 2.95 per cent. of soluble salts, and 97.05 of insoluble salts,—the latter consisting of 64.98 of carbonate of lime, 0.93 of magnesia, 5.03 of phosphate of lime, 4.18 of phosphate of magnesia, 1.04 of peroxide of iron, 2.42 of alumina, 17.28 of silica, and 1.79 of loss. A mere glance at these analyses will convince an intelligent farmer of the value of bark as a manure, and show him that, whenever he can obtain it, he ought not to be deterred from using it by the slowness of its decomposition. Refuse tanners'-bark, in particular, is, in many places, easily obtainable, and ought to be considerably appreciated; for though it injuriously differs from pure bark in the loss of its soluble salts, it also beneficially differs in the acquisition of nitrogenous animal matter; and it may be very advantageously employed either as an ingredient in farm-yard compost, as a top-dressing on some grass lands, or as a simple manure preparable for use by either rotting or incineration. "The bark of trees, in general, and especially that of oak," says Mr. Mills, "contains a very rich salt, extremely useful in vegetation. One load of oak-bark, laid in a heap and rotted after the tanners have used it for dressing of leather, will do more service to stiff cold land, and its effects will last longer, than two loads of the richest dung. Mr. Miller is right in thinking it better for cold strong land, than for light hot ground, if it be used alone as taken from the tan-yard, because it is of a warm nature, and will loosen and separate the earth so effectually, that by using it only three or four times, a strong soil, not easy to be wrought, will be rendered perfectly light and loose. But by mixing it with earth of a nature contrary to that which it is intended to correct, and in proportion suited to the nature of the soil it is to be laid on, it will prove a fine manure for almost any land, its salts being such

as will greatly fertilize the ground. It will even alter the very nature of the soil, and turn it into a rich black mould. It necessarily abounds in vegetable parts, derived from the tree to which it once belonged, and cannot but be strongly impregnated with animal juices, as it lies a long time in the tan vats, with the skins and hides of animals,—circumstances which must make it singularly beneficial to all poor lands. If laid on grass, it should be spread soon after Michaelmas, that the winter rains may wash it into the ground; for if it be laid on in the spring, it will be apt to burn the grass, and, instead of improving it, will thereby do it much injury for that season. When used for corn land, it should be spread before the last ploughing, that it may be turned down for the fibres of the corn to reach it in the spring; for if it lies too near the surface, it will forward the growth of the corn in winter; and in the spring, when the nourishment is chiefly wanted to encourage the stems, it will be nearly consumed, and the corn will receive but little advantage from it. Mr. Bradley advised a gentleman, to whom a considerable quantity of bark was left upon the expiration of the lease of a tan-yard, to lay some of it upon a piece of stubborn sour land; which he did with such success that his product was admired by all the gardeners and farmers in the neighbourhood. For such ground, he thinks it should be mixed with a sandy soil, and that one-third of bark to two-thirds of sand will be very sufficient proportion for clays, laying on about 160 cart-loads upon an acre. All barks or rinds of trees, though not of so high a value as that of oak, must of necessity enrich either corn or pasture ground, if broken into small pieces and laid upon it. They must needs be much richer than the mould or earth usually found in the bodies of old, large, hollow willow-trees, putrified within; though this is justly esteemed very efficacious."

The barks of many trees are used for not a few purposes in manufactures, economics, and medicine. The bark of the cork-tree yields the important and universally known cork of commerce. See CORK. The bark of the *Quercus nigra* or *Quercus tinctoria*, is extensively imported from North America, and used in dyeing, under the name of quercitron-bark. The bark of various species of the poplar and the willow has often been successfully employed as a febrifuge in intermittent fever. The bark of the Cinchona-trees of South America has long been favourably known in materia medica, under the name of Jesuit's bark and Peruvian bark, and now furnishes the quinine and the cinchonina of modern medicine and chemistry. The bark of the willow, the lime-tree, and the cocoa-nut-tree is so tough and fibrous as to have been manufactured into ropes and other kinds of cordage. The bark of the lime-tree, the bread-fruit-tree, and the paper-mulberry-tree, is torn into slips, and manufactured into mats. The bark of the bread-fruit-

tree and the paper-mulberry-tree, is macerated and beaten in water into a thin and flexible texture, which serves the same purposes as linen. The inner layers of the *Daphne lagetto*, or lace-bark-tree of Jamaica, are, with but slight manipulation, converted into a soft, flexible, delicate, beautiful reticulated texture closely resembling lace. The quantity of bark for tanning or dyeing imported into the United Kingdom in 1842, was 645,747 cwt., of which 310,885 cwt. was from Belgium, and 159,168 cwt. from Holland. Of Peruvian bark the amount imported in 1842 was 1,125 cwt.—*Monteath's Forester's Guide*.—*Davy's Agricultural Chemistry*.—*Keith's Botanical Lexicon*.—*Boussingault's Rural Economy*.—*Liebig's Chemistry of Agr.*—*Loudon's Gardener's Magazine*.—*Journal of the R. Agr. Society*.—*Mill's Husbandry*.—*Marshall's County Reports*.—*Mortimer's Husbandry*.—*Mirbel's Traite d'Anatomie et de Physiologie vegetale*.

BARK-BED. A bed of tanners' bark in a glass-covered brick pit or low glazed brick house. Its object is to produce and maintain warmth and dampness by the fermentation of the bark; and it is used for the cultivation of pine-apples, and such other tropical plants as require what gardeners call bottom heat; but, except for raising young plants from cuttings, it is not employed for the cultivation of greenhouse-plants. Bark in a coarse form or in large pieces, and not ground or greatly broken bark, should be employed, else a slowly evolved and a steady heat will not be produced; and it should be spread in the sunshine and covered with mats till fermentation commences, and then deposited in the glazed brick pit, where its use is required. The heat, for two or three days, is much too great; but when it has fallen to 90° , it is in a proper state for the pots containing the plants to be plunged in it; and it may continue to be used while it slowly decreases to 66° , and may then be renewed to about 70° or 80° by such a stirring as will produce a second fermentation, or by mixing with it a small quantity of yeast. But even the best bark-bed seldom maintains heat so long or so uniformly as is desirable, and generally either fails in some degree to achieve its purpose, or requires to be aided by steam-pipes, hot-water, or smoke-flues; and, under the improved practices in horticulture, it is rapidly in the course of being discontinued and forgotten. The use of steam-pipes, and pipes of hot-water in particular, begins to be so well understood, and so generally appreciated, that the bark-bed or bark-stove is seen to be a clumsy and comparatively inefficient appliance. Yet where the old method of bottom-heat is still preferred, or where it is required on only a small scale, the use of oak-leaves, or of any other vegetable substance containing a large proportion of tannin, will serve the purpose quite as well as tanners' spent bark, and in many instances far better.

BARKING. The artificial peeling of the bark

of trees. The chief practice of it is upon the oak and other tanniniferous trees, for the supply of bark to tanners. The barking of oak is usually practised at any time from the beginning of May till the middle of July; but the sooner it is performed in spring, the better is the bark, the more easily is it detached, and the greater an impetus is given to the re-growth of coppice-wood. When the sap has begun to rise, and before the leaf is completely developed, the very best crisis has arrived for barking. After the sap freely ascends to the leaf, and after the leaf is fully formed, the bark becomes less juicy in itself, and more difficult to be detached from the wood; and when the cambium or what is called the black sap is descending, the excorticated bark begins to throw off a scarf from its exterior, becomes dark-coloured in its innermost layers, and loses a comparatively large proportion of its most useful juicy properties. All oak-bark for the tanner ought, at latest, to be removed from the tree before the third week of June; and every ton of it which is removed after the first of July is not only impoverished in tannin, but weighs two cwt. less than if it had been removed before the end of May, or at latest in the first week of June. The birch and the larch may be peeled nearly a month earlier than the oak. Yet the birch is usually not barked till July or even the beginning of August; for its dead bark, which is useless to the tanner, and which would impede the grinding of the inner bark in his mills, cannot properly be separated and thrown away till the alburnum of the season is fairly formed, and therefore not till about the end of July. The trees to be barked are either the cut thinnings of the coppice, or the felled old oaks of the forest: and they are dealt with by the forester and his best instructed assistants in a way which will be noticed in our article on COPPICES and WOODS. But in cutting down the trees, no portion of bark should, on any account, be peeled from the root or stool, and care should be used to make each tree so fall as not to tear or otherwise damage the stool-bark of its neighbours.

The prevailing method of barking, and the tools usually employed in it, previous to comparatively recent improvements, are described as follows by Nicol:—"A piece of vacant ground, at a convenient side of the wood," says he, "is to be looked out, to which the large and small wood is to be carried, here to undergo the operation of barking. The barkers are furnished with light short-handled mallets made of ashwood, the head about 8 inches long, 3 inches in diameter at the face, and the other end blunt, but somewhat wedge-shaped; and with sharp wedges, made of the same sort of timber, somewhat spatula-shaped: these, from their form, may either be driven by the mallet, or pushed by the hand. The barkers are also provided with a smooth whinstone, about 6 or 8 inches in diameter on the face, and 4 or 5 inches thick. The young

saplings, small branches or twigs, are held by one hand on the stone, and with the other beaten by the mallet until the bark be split on the wood: it is then peeled off, and laid regularly aside, till a bundle of a considerable size be formed. The larger branches, young trees, and full grown timber trees, are laid along on the ground: the upper side of the tree to be barked is beat with force by the mallet from one end of the tree to the other. The bark is then started at the thick end, by thrusting or driving in the wedge, which being thrust along the whole length, the bark is speedily ripped open. The wedge is then applied under the bark at both sides of the incision. The firm parts are then successively beaten by the mallet, and the wedge gradually pushed along till the whole be completely severed from the timber. The point most particularly to be observed in this art, is the taking off the bark in as long shreds as possible, for the conveniency of carriage to, and drying it on, what are called the horses. These are formed of long branches, and two or more pieces of about a yard in length, sharpened at one end, and having a knag or fork at the other to receive and support the long branch. The horses may stand within 4 or 5 feet of each other, and so as to have a declivity from one end to the other, that the occasional rains may the more easily run off. A dry elevated spot, in an airy place, is the most proper for erecting the horses upon, in order that the bark, when laid upon them, may have a free circulation of air when drying. At the end of each day's work, the bark is carried to and laid across the horses, to the thickness of 6 or 8 inches. The larger boardy pieces of bark are built into small pyramidal stacks, or set up on end leaning against the horses. If the weather be very dry and fine, the bark should be turned twice a-day, or at least once a-day. Gentle showers are found beneficial to it, while severe rains, of long continuance, are very hurtful. A careful hagman will take pains to lay the strong boardy pieces of the bark in such a manner as to defend the more tender parts from severe rains. Great care is to be used to preserve the colour of the inner bark; because the colour of this is generally looked to as a principal criterion of its value. When it is sufficiently dry to be in no danger of fermentation, it should be carried to a dry house or shade. Where such cannot be had, it should be stacked up in the same manner as hay. It may be proper to notice here, that stacks of bark should not be so large as to incur the risk of their fermenting. Narrow and long stacks will answer best. After being built up, they should be instantly thatched, however promising the weather may be. Straw, bog-reed, long heath, or broom, may with equal propriety be the material employed as thatch."

This method of peeling, drying, and harvesting is still regarded as perfectly eligible, and may, in most circumstances, be advantageously practised;

yet it admits of obvious and easy improvements, both in peeling the larger bark, and in drying and harvesting the whole. The great objects are to beat the bark as little as possible, to take it off in clean, large pieces, to dry it without darkening its colour, and to store it without incurring a risk of fermentation. The beating of small branches and very small stems with the mallet is often indispensable for barking; and a little beating of comparatively sapless larger branches and stems may also be unavoidable; but, in general, the beating of all good stems and tolerably large branches, is quite unnecessary, and has a certain tendency to blacken the inner or fleshy layers. Incisions are made round the stem, at distances of from $2\frac{1}{2}$ to 3 feet, with a sharp instrument, resembling a hedge-bill; an incision is made along the stem, so as to cut the circular incisions at right angles; and the stem being, if possible, raised against some support, an instrument called a peeling-iron—about 6 inches long, $1\frac{1}{2}$ inch broad in the face, sharpened like a wright's chisel, a little bent in the broad way, and having a wooden handle of about 4 inches in length—is so facilely and dexterously applied, that the whole of each section of the bark is taken off, in as clean, regular, and uniform a condition, as a skin from the carcass of a sheep or a calf. The best method of drying is on temporary rustic lofts, of about two feet in width, and of length sufficient to hold one day's peeling of bark. Each loft is formed by driving forked stakes into the ground for bearers, about 3 feet high in the back row, and $2\frac{1}{2}$ in the front, and by laying loppings between the forks so as to constitute a rustic sloping floor. The smaller pieces of bark, or those from branches and minor stems, are laid, to the depth of six inches, on the sloping floor, with their thick end toward the higher side; and the broad and large pieces are placed over the whole in such a position as to carry off any rain which may fall. In three or four days, the whole of the bark should be turned, to prevent it from heating or moulding; and in about ten days, it will be sufficiently dry to be stacked or otherwise stored. The width of each pile, in stacking, ought not to exceed 8 feet.—The barking of all other tanniniferous trees, excepting the birch, is performed in the same manner as that of the oak; and the barking of the birch simply includes the additional process of peeling off and rejecting the outer, shreddy layers of dead bark.

The barking of vines and fruit-trees has, for a considerable number of years past, been somewhat extensively and very successfully practised, both in England and on the continent, for improving both the quality and the size of fruit. At the winter pruning in February, the gardener or orchardist, with his common hooked pruning-knife, cuts off all the outer bark of every apple or pear tree above 8 or 10 years old, but removing a thicker stratum from an older tree than from a younger; and when he judiciously or care-

fully performs the operation, he invariably has the satisfaction of seeing the fructiferous properties of the trees immediately and decidedly improved. Vines under glass in England are treated in the same manner. This practice of barking of fruit-trees is called *nettoyis* in France and Belgium, and was introduced to Great Britain about the year 1816 by Mr. Lyon of Edinburgh. *Nicol's Planter's Kalendar*.—*Monteath's Forester's Guide*.—*Treatise on Planting in Lib. of U. Knowledge*.—*Marshall's Rural Economy of Yorkshire*.—*London's Gardener's Magazine*.

BARLERIA. A genus of tender, evergreen, ornamental plants, of the acanthaceous tribe. About a dozen species are cultivated in the hothouses of Great Britain; and all of these, except two, are natives of the East Indies. The long-leaved species is a biennial herb, of two feet in height; and the other species are perennial shrubs, of from two to four feet in height. One of the two species not from the East Indies is West Indian, and is probably the longest and best known in Britain. It is called a snapdragon in Jamaica, and the greater impatient Venus looking-glass by Miller. Its stem is hairy, branching, jointed, and about 4 feet high; its leaves are oval, and grow in pairs and opposites, on short footstalks, at each joint of the stem; its flowers grow one by one at each division of a ramified or divided long footstalk, which is produced at each division of the branches; each flower has a long pale tube, and a fine blue labiated summit; and each seed-vessel is an oblong, membranaceous, two-celled capsule, and parts with its seeds by an elastic jerk. The juice of the leaf of one of the East Indian species, *Barleria prionitis*, is a favourite medicine of the Tamool practitioners, in those catarrhal affections of children which are accompanied with fever and much viscid phlegm.

BARLEY,—botanically *Hordeum*. A genus of grasses, next in importance, in the British Islands and in many other parts of the world, to the genus *triticum* or wheat. Some of the species, indeed, rank as mere weeds, with scarcely an English name; others rank as coarse herbage, under the name of barley-grasses; and both of these groups ought, according to our usual practice, to be noticed under the word *HORDEUM*; yet, for the sake of affording a full view of barley in all its connexions, we shall discuss the whole in the present article.

Ancient Barley.—Barley, as a cereal grass, was known at a very early age of the world, and figures in remote records of both sacred and civil history, and has been unintermittedly and extensively cultivated, in many parts of the world, from ancient times till the present day. During the hail-plague which fell in Egypt, previous to the exodus of the Israelites, "the flax and the barley were smitten; for the barley was in the ear, and the flax was balled." In the peculiar system of sacred law, which was established over the Israelites through the ministry of Moses,

"an homer of barley-seed was valued at fifty shekels of silver." The land of Canaan, when the Israelites were about to be conducted into it as their patrimony, was described to them as "a good land, a land of brooks of water, of fountains and depths that spring out of valleys and hills, a land of wheat, and barley, and vines, and fig-trees, and pomegranates, a land wherein they should eat bread without scarceness." When Naomi and Ruth travelled from the land of Moab into the country of the Israelites, they "came to Bethlehem in the beginning of barley harvest;" and the latter obtained the notice and the favour of Boaz in connexion with the gleaning and the winnowing of barley. David, at a critical moment, during the rebellion of Absalom, received from some of his loyal followers an opportune supply of "beds, and basins, and earthen vessels, and wheat, and barley, and flour, and parched corn." The seven sons of Saul, when delivered to the Gibeonites, "fell all seven together, and were put to death in the days of harvest, in the first days, in the beginning of barley harvest." When Solomon was at the apex of his great princely glory, "his officers provided victual for king Solomon, barley also and straw for the horses and dromedaries." When Jotham prospered as king and conqueror, the Ammonites, on being subdued by him, gave him annually, for three years, "an hundred talents of silver, and ten thousand measures of wheat, and ten thousand of barley." Other ancient notices of barley in the sacred record are equally explicit; and some of them occur in association with circumstances and lessons of deeply impressive character.

Pliny, the Roman naturalist, gives such a description of the *hordeum* known and cultivated in the first century as completely identifies it with the British barley of the present day. He says that the root of *hordeum* comes out of the opposite end of the seed from the blade, that the radical end of the seed is larger than the blade end, that the blade of *hordeum* is rougher than the blade of *triticum*, that the ear of *hordeum* is almost bare, while that of *triticum* is covered with many coats, that *hordeum* has a shorter stalk but a rougher and sharper beard than *triticum*, and that some kinds of *hordeum* have only two rows of grain in the ear, while other kinds have five. Columella mentions two kinds of barley which were cultivated in Italy, the one called *hexasticum* or *cantherinum*, and the other called *distichum* or *galaticum*. Cato also speaks of barley, and classes it with such crops as are exhausting to land. Palladius says that barley delights in an open and dry soil, and, if sown upon a wet soil, dies. Virgil says, "When the sun in Libra makes the days and nights equal, then sow barley, even towards the distant showers of the impracticable winter solstice." Varro says that six modii of barley ought to be sown upon a jugerum. Other Roman notices of barley are quite as distinct, and show it to have been a

generally cultivated grain; and a few of them even give minute directions as to the mode of treating it, which would be highly instructive to many a modern farmer.

Generic character.—The flowers of barley are hermaphrodite, and are arranged into a compact spike, in alternate order on each side of a terminal rachis. They consist of imbricated bracts; and the exterior of these bracts are husks or glumes, while the interior, which immediately enclose the organs of fertility, are paleæ, or chaff. Three florets constitute a spikelet, and two glumes belong to each floret. The glumes are extremely narrow, very unlike those of wheat, and amounting to little more than bristles. The paleæ are two and alternate, the inner one closely investing the seed, and the outer one enwrapping and folding over the inner, and furnished with a long awn, beard or arista, beset with three rows of acute, upward-pointing bristles. The scales at the base of the outer paleæ are two in number, and very minute; and near them, in the situation which botanists call hypogynous, or fixed below the base of the seed, are the three filaments, with their three anthers, which lie concealed within the paleæ. The ovary is simple, the styles are two, the stigmas are feathery—and these also are concealed. The pericarp is generally not distinguishable from the seed. The albumen of the seed is farinaceous; and the embryo lies on the outer side of the albumen at its base. The cotyledon and the plumule are developed; and the root becomes a fibrous rhizoma. The culm, which becomes the straw, is cylindrical, closed at its nodes or joints, hollow in the spaces between the nodes, and coated on the exterior with a silicious or flinty secretion. The leaves are alternate, and have a split sheath investing the entire spaces of the culm from node to node.

Barley is regarded as constitutionally more tender than some other cereal grasses, and, in many instances, cannot bear the rigour of our ordinary winters; and yet it grows wild over a wide extent of both the old world and the new,—it is successfully cultivated athwart a greater breadth of the globe than any other of the valuable grains,—it flourishes under the heat and drought of the borders of the torrid zone, and grows sturdily and maturely on the northern verge of the temperate zone,—and, in general, it thrives and ripens, in not a few exposures and under various adverse circumstances, which the constitutionally harder wheat is totally unable to resist. This singular phytological paradox is partially, if not wholly, explained by the peculiar nature of barley's inflorescence. If a young green ear be examined, it will be seen that the spikelets—then closely packed together on each side of the rachis—consist each of three distinct florets, each with its pair of slender setaceous bracts, and that the central floret is larger and more prominent than the side ones, and furnished

with a long bristly awn which reaches quite or nearly to the summit of the spike. On opening this central floret with a needle, the rudiments of the seed, stamens, and stigma, will be visible with the aid of a magnifying glass; but on opening the side florets, they will, in the case of all the two-rowed barleys, be seen to consist of little more than the very imperfectly formed integuments of glumes and paleæ, and to be in consequence barren. When the stamens, anthers, and styles of the fertile florets are completely formed, they will be seen to conduct the process of impregnation under phytological circumstances which afford a peculiar protection from exterior disturbance, and from most of the ordinary causes of injury. In wheat, the three filaments, with their delicate versatile anthers, are protruded and exposed to every vicissitude of the weather; but in barley, these vital organs, while equally perfect in organization, are masked and protected by the floral integuments. The latter's process of impregnation, therefore, is conducted, through all its stages, in complete shelter from wind, rain, and hail; it escapes all the most serious risks of miscarrying to which the impregnation of wheat is exposed; and, in particular, it is free from the disastrous liability of being damaged or rendered barren at the critical moment when the pollen is liberated by the expansion of the anthers.

The Species of Barley.—Many writers classify all barley, according to the time of sowing, into winter barley and spring barley. But some varieties of confessedly the same species, or of strictly similar botanical characteristics, are so hardy as to be quite suitable for winter growth, while others are so tender that they can be sown only in spring; and several kinds, whether species or varieties, which suit best for autumn sowing, and are with the greatest propriety designated winter barleys, may with perfect success be treated also as spring barleys.—Other writers classify all barley, according to the number of rows of grains in the ears, into six-rowed, four-rowed, and two-rowed barleys. But all four-rowed kinds are partially six-rowed, and can easily be proved to be mere deteriorations of true six-rowed kinds, or deviations from them; and the two-rowed kinds are so exceedingly diversified as clearly to require amongst themselves a specific classification.—Other writers classify all barley, according to the adhesion or non-adhesion of the corolla to the ripe seed, into awned and naked. But this distinction, though a very marked one for the popular observer, accords ill with either the botanical distribution or the phytological habits of the different kinds, and besides is far too limited for the purposes of either assisting the memory or making a discrimination of qualities.—Other writers classify all barley, according to the barrenness or fertility of the side florets, into flat-eared and square-eared barleys. But this distinction merely resolves the six-rowed and the partially four-

rowed kinds into one class; it burdens itself with exceptions and explanations, to account for the differences between the six-rowed and the four-rowed; and it groups all the numerous and the widely different kinds of two-rowed into one undistinguished mass.—Other writers classify all barleys into Scotch and English,—calling the six-rowed and the four-rowed kinds Scotch, and the two-rowed kinds English,—and subclassify all the latter, according to their earliness or lateness of ripening, into rath-ripe barleys and late-ripe barleys. But any late-ripe sort, which has been grown for some years upon strong and cold soils, will become rath-ripe by being sown a few times upon light dry soil, and will retain its acquired early habit for three or four years upon its original cold soil; and any rath-ripe sort, which has been grown upon light warm soil, will be rendered late-ripe after a few years' cultivation upon cold heavy soil.

All these distinctions, in fact, not only exclude the whole of the weeds and the mere herbage grasses of the barley genus, but are considerably too narrow for the purposes of practical agricultural classification. The number of species, as determined by permanent and well-defined botanical characters, and quite irrespective of the multitudinous varieties of some of the cultivated kinds, is fifteen according to Professor Kunth, and eighteen according to Loudon's *Hortus Britannicus*; and even the number of cultivated species, including the cereal grasses of other countries, and the useful herbage grasses of our own land, is variously stated at not fewer than from eight to ten. Every intelligent farmer, therefore, ought clearly to be acquainted with a wider range of classification than most agricultural writers exhibit. Yet the distinctions of winter and spring barley, and of rath-ripe and late-ripe barley are of important practical use. Winter barley is usually of the four-rowed and six-rowed kinds, and is sown principally in countries, such as Spain, Italy, and the south of France, where winter is mild and the spring is dry, or such as Russia, Poland, and some portions of North America, where snow lies throughout winter, and a genial and steady sun-heat usually commences with the disappearance of the snow. Spring barley seldom yields so large a produce of grain as winter barley, and is likewise so much later in ripening as to interfere, in some degree, with the wheat harvest; yet it incurs far less risk, and on the whole is more suitable in a climate, like that of Great Britain and Ireland, where the winter is an alternation of frosts and thaws, and the early part of spring is usually cold and wet. Rath-ripe varieties of spring barley generally yield a smaller produce of grain than late-ripe varieties; and therefore ought not to be preferred to the latter except for cold late soils, or with the express design of affording an early barley-harvest.

The Barley-grasses.—The meadow barley-grass,

Hordeum pratense, is perennial, and grows wild in the moist meadows of England, but is rare in Scotland. Its side florets are barren, and have a short beard; its glumes are rough and bristly; its culms are kneed, not very straight, and grow to the height of about two feet; its foliage is scanty; and its roots are fibrous. It flowers in June, and ripens its seeds in August. It is adapted to irrigation, has very hardy habits, contains a large proportion of nutritious matter, and often occurs naturally on good rich meadow-land. Yet it yields a comparatively small amount of herbage; it is liable to rust; its seeds cannot be very easily procured; its long sharp awns are in risk of irritating and inflaming the gums of cattle; and, on these accounts, it can scarcely claim to be worthy of cultivation.

The wall barley-grass, mouse-barley, or way-bonnet grass, *Hordeum murinum*, is an annual weed, of the salt marshes, way-sides, beaten-paths, and other waste grounds of Great Britain. Its root is fibrous; its culms ascend in numbers from one root, to the height of about 15 or 18 inches, and they have three or four joints, and are procumbent at the base, erect in the upper parts, and considerably thicker than those of the meadow barley-grass; its spikes are brittle, two or three inches in length, of a dirty yellow colour, and less slender than those of the meadow barley-grass; and its long, stiff awns, when they enter into the composition of hay, are apt to inflict damage on the mouths of horses. It is said by Withering to be eaten by horses and sheep; yet is asserted by other careful and competent observers to be uniformly avoided by even half-famishing animals which feed by the road-sides. Its proportion of nutritive matter is exceedingly small, and consists principally of mucilage and insoluble extractive matter. It flowers from April till August, and ripens its seed about the beginning of the latter of these months.

The sea barley, or squirrel tail grass, *Hordeum maritimum*, is also an annual weed of the salt marshes, and the sea-shore pastures and maritime sandy ground of Great Britain. It resembles the wall barley-grass in general habit, but is smaller and more glaucous, and has rougher awns, with minute bristly teeth. It grows to the height of about a foot, and flowers in June and July. It abounds in the Isle of Thanet, but, in general, is of scattered and comparatively scarce occurrence.—The bulbous barley-grass, *Hordeum bulbosum*, is an uninteresting perennial of Italy; it was introduced to Great Britain in 1770; and it grows to the height of three feet, and flowers in July.—The cape barley-grass, *Hordeum Capense*, is an uninteresting annual of the Cape of Good Hope, and was introduced to Britain in 1817; and it grows to the height of about a foot, and flowers in July and August.—The maned barley-grass, *Hordeum jubatum*, is a curious biennial of North America, and was introduced to Britain in 1782; and it grows to the height of about a foot,

and flowers in July and August.—The porcupine barley-grass, *Hordeum hystrix*, is a curious annual of Spain, and was introduced to Britain in 1821; and it grows to the height of about a foot, and flowers in June and July.

The Cereal Barleys.—All the cultivated barleys rank as annuals; yet most of the six-rowed kinds are sown toward the close of autumn, and treated as slightly biennial, while one of these kinds succeeds well to be sown in summer, and treated as thoroughly biennial. Great confusion prevails in classifying the six-rowed barleys, and distinguishing their species and varieties. Most of this confusion arises from mistaken notions of the six-rowed and the four-rowed kinds, and may be prevented by a little definition. "There is no barley," remarks Professor Low, "to which the term four-rowed can be (properly) applied. Barley is termed two-rowed or six-rowed, according to the number of its fertile florets. In two-rowed barley, one row of florets in each of the two sides of the spike is fertile, and consequently one row of seeds on each side is perfected. In six-rowed barley, three rows on each side of the spike are fertile, and consequently three rows on each side are perfected. In this sense only, it is termed six-rowed barley. But there is no species known to us in which only two rows on each side of the spike are fertile. Slightly examined, indeed, six-rowed barleys frequently present the appearance of four rows; but this is in appearance only; for such barleys have always the three rows on each side perfect. In poor soils and unfavourable situations, two of the rows run much into each other, and this has perhaps given rise to the mistake; but the two rows which thus run into each other in appearance, are on the opposite sides of the rachis." The name *hexastichon* or six-rowed, which has usually been restricted to one well-marked species of six-rowed barleys, would thus become the proper designation of the whole, and is so used by Professor Low. Yet the alteration or disturbance of established names is exceedingly undesirable, and in this case unnecessary, the mere definition of them being quite sufficient. By *hexastichon* or six-rowed, as distinguished from every other kind of barley, we mean a species which is always truly six-rowed, and whose ears stand out from one another in the spreading and characteristic manner of two-eared sprat or battledore barley; and by all other square or six-rowed barleys—beginning with *Hordeum vulgare*, and ending with *Hordeum Nepalense*—we mean barleys which, while always six-rowed at the base, are usually more or less four-rowed at the top, according to soil, culture, and phytological habit, and whose ears lie compactly toward one another in the manner of the ears of bere or bigg.

The common barley, usually, though improperly, called the four-rowed barley, *Hordeum vulgare*, seems to have been a native of the south of Europe, particularly of Sicily, but was intro-

duced to Great Britain and to the countries of central and northern Europe, at too remote a date or in too obscure circumstances to be known in record. In common with every other cereal species of barley, it ranks as an annual plant; yet it furnishes the chief varieties of cultivated winter barley, and is therefore practically a biennial. All its florets are fertile; its middle grains form two distinct rows; and its side grains form a kind of double row toward the base, but unite in such a manner as to form one row toward the top; and yet, in some instances, they remain so nearly separate from base to extremity as to render it a true six-rowed barley. Three of its varieties are so conspicuous as to be pretty generally treated as distinct species; and many are so obscure, so fugitive, or so worthless as to have challenged scarcely any notice.

Bere, bigg, barley-bigg, or rough barley, is one of the best known and most extensively diffused varieties of common barley. It is cultivated in Denmark, in Sweden, in Russia, throughout the Scottish Highlands and Hebrides, and on exposed light grounds in the hilly portions of the Scottish Lowlands. Its ear is about $2\frac{1}{2}$ inches in length; the number of grains in each ear is about sixty; the grains taper or have a pointed form at both ends; and the awns are about $3\frac{1}{2}$ inches in length, and adhere to the grain. Though its grains are more numerous than those of the two-rowed kinds of barley, yet they have less weight in proportion to their bulk. Bere is, in consequence, regarded as an inferior crop, fit only for bad cultivators, or for poor cold lands; but it ripens very early when sown in spring, and is therefore a great and beneficial boon to climates which are too cold and late to ripen the better kinds of barley.—The square barley, called in France *orge carée*, differs from bere in having a thinner skin, and in being three or four days sooner ripe; yet in other respects so closely resembles it as to be almost identical. It is extensively cultivated in some parts of Germany.—The white four-rowed winter barley, called in France *orge carée d'hiver*, has thicker and longer ears, thicker-skinned, and larger grains, and an aggregately coarser appearance than bere; and the lower three or four tiers of its florets are frequently barren. It is extensively cultivated in the north of France, and has the reputation of being very suitable for malting. When sown in autumn—as is the usual practice with it in France—it ripens before any of the spring-sown barleys; but when sown in spring, it does not ripen till a fortnight after the latest of these barleys.—The Tangier, Morocco, or African barley, is shorter in the ears and the straw, and larger, thicker-skinned, and less plump, than the preceding variety; its awns are long and spreading, and are not easily separated from the grain; and its foliage, when green, is very broad, and is greedily devoured by rabbits and hares. It was, not many years ago, introduced to Great Britain from Morocco.—The Bengal barley re-

resembles the Tangier variety, but is not so strong in the straw.—The giant barley, *Hordeum giganteum*, has been regarded as one of the most permanent varieties of bere; yet it is characterized principally by its tallness, usually growing to the height of about four feet, while bere grows to the height of only three. It was introduced to Great Britain from the Levant.

The black winter barley, called in France *orge carée noir*, and sometimes called botanically *Hordeum nigrum*, has so marked a character as to have been sometimes treated as a distinct species. Its spike is long; its grains are from 60 to 70 in number, and larger than those of bere; its paleæ have a black or dark-bluish colour, and are alluded to in its distinctive name of 'black;' and its awns are long and dark-coloured, and adhere to the grain. In spite of the blackness of its paleæ, it yields as white flour as any other sort of barley. It is very prolific, but is not liked by maltsters. It is less hardy, but more early, and better adapted for spring-sowing than the white four-rowed winter barley; yet, if not sown very early in spring, it vegetates as a biennial, and will not run to seed till the following year. The French either sow it before the end of March, in order to reap its grain as an annual, or sow it in June and July in order to feed sheep with it, and to enjoy its advantages as a biennial.

The Siberian barley, or four and six rowed naked barley, is regarded sometimes as a variety of common barley under the name of *Hordeum vulgare nudum*, and sometimes as a distinct species under the names of *Hordeum coeleste* and *Hordeum gymno-hexastichon*. Its ear is shaped like that of bere, but is more decidedly six-rowed; the grains are more numerous than those of bere, and considerably smaller than those of other kinds of naked barley; and its awns are rather upright, easily detached when ripe, and so readily falling off with the paleæ or husk as to render the barley, in technical phrase, 'naked,' like wheat. It was introduced to Great Britain in 1768, and promised, for a time, to become a favourite grain, and to pass into general cultivation. But, whether from prejudice, from bad management in the trials of it, or from ascertained unsuitableness to the soils and climate where it was tried, it soon ceased to be much noticed. Yet it is extensively cultivated in the north of Europe, in Germany, and in some parts of France; it is generally held in high esteem, on the continent, for its fertility; it is regarded, in some parts of Germany, as the most valuable kind of barley known; it obtained its distinctive botanic name of *coeleste* from the French, in compliment to its supposed eminent productiveness; it has been much extolled by several distinguished agricultural writers of the continent, particularly by the eminent and well-known Thaer; it ripens in our country a week earlier than bere; and it both deserves attention and a fair trial in the improved agricultural districts of Great Britain,

and might be found a valuable acquisition, as a substitute for bere, throughout the Scottish Highlands and Hebrides.

The Nepaul barley, Himalaya naked barley, or Nepaul wheat, is generally treated as a distinct species, under the name of *Hordeum nepalense* or *Hordeum trifurcatum*. It grows wild on the Himalayan mountains, near the line of perpetual snow, and was introduced thence to Great Britain in 1817. It was regarded as wheat by the parties who introduced it; and even yet is sometimes called Nepaul wheat; yet not only is it a true barley, but it differs from the Siberian kind, or *Hordeum coeleste*, principally in the form of its awns, and is, like that kind, six-rowed, naked, early, and prolific. Its awns are very short, and generally bent down upon the chaff or inner paleæ, while the wings of the outer paleæ rise to about one-eighth of an inch on each side, and form with the awn a sort of three-forked termination, which is alluded to in the specific name *trifurcatum*. The three-forked termination, however, is not a permanent character; for the grain, after being cultivated for some time in Britain, elongates its awns like those of Siberian barley, or even exhibits on one ear some grains with short awns and trifurcati, some with long and erect awns, and some with awns of intermediate length and form. The Nepaul barley is earlier than the Siberian; its straw is short, and, under favourable culture, stiff and erect; and its foliage, when young, is broad, and of a glaucous green colour.

The true six-rowed barley, Pomeranian barley, or six-rowed white winter barley, *Hordeum hexastichon*, is the coarsest in sample of all the barleys, but hardy and prolific. Professor Low regards it as simply the sprat barley, or *Hordeum zeocriton*, with all the side florets as well as the central ones fertile, and calls it six-rowed sprat barley, or *Hordeum hexasticho-zeocriton*. Its grains are situated in six distinct and equidistant rows; and the lower ones spread out at nearly right angles with the rachis, so that the awns are exceedingly divergent. All its florets are hermaphrodite and awned; its spike is thicker and much shorter than that of bere; the number of grains in a spike or ear is about one-third greater than that in a spike of bere; and its grains are long, and not well filled, and have the awns adhering to them with great tenacity. This species is occasionally sown in France and in England as both a winter and a spring barley, and succeeds well under either treatment; but it is usually a fortnight later in ripening than bere. No defined or marked varieties of it, or deviations from its normal character, are in cultivation.

The sprat, spelt, fan, battledore, rice, or Putney barley, or German rice, *Hordeum zeocriton*, is a two-rowed species, easily distinguished to even the unpractised eye by the spreading form of its spike, alluded to in the names fan and battledore. Its spike is short, broad at the base, and some-

what tapering toward the top; its grains stand out from the rachis, in a manner almost resembling the expanded wings of a bird; its awns spread very divergently on both sides; and its entire appearance, with the exception of the number of its rows, is precisely similar to that of *Hordeum hexastichon*. Professor Low, as already observed, regards the two species as one, with the accidental difference of barrenness or fertility in the side florets; and he calls sprat barley *Hordeum disticho-zeocriton*. The name Putney barley, sometimes given to it, alludes to the fact of its having at one time been extensively cultivated in the vicinity of Putney; and the names rice barley and German rice are given to it, not on account of its possessing any resemblance to rice, but because, as decorticated or pot-barley, it swells much by boiling, and forms a tolerable substitute for rice in broths and puddings. It was at one time in considerable favour with English farmers, and is still much esteemed in Germany; but it has gone almost completely out of cultivation in England, and is thought by some scientific agriculturists to be undeserving renewed attention. Yet, except for the shortness of its straw, it might be found profitable for some soils and situations, particularly for marly lands, in a bleak or cold district; it is, at all events, both hardy and productive; and it ought, at least, to be kept in view by experimental and enterprising farmers.

Two-rowed or long-eared barley, *Hordeum distichon*, is the species commonly cultivated in England and the lowlands of Scotland. It has ramified itself into several well-marked, generally diffused, and highly esteemed varieties; and it is also identical, as a species, with very numerous varieties of inferior value, local diffusion, or ill-defined and fugitive character. All its side florets are male and barren, and are more minute and less distinct than those of six-rowed barleys; its spike or ear is considerably longer than that of six-rowed barleys, and is as broad at the centre and the top as at the base; and its grains are more imbricated than those of sprat barley, or are so situated as to overlap one another instead of spreading out from the rachis. The number of its grains in an ear usually ranges from twenty-four to forty, according to the variety, while that of the six-rowed barleys ranges from about sixty to seventy; yet, in spite of this great inferiority, the two-rowed barley has obtained a very decided preference, and a very superior care from farmers, not only in Great Britain, but in France and in many parts of Germany. The greater actual produce of the two-rowed barley is the apparent reason of the preference, and the greater fineness of the sample was probably the inducing or original reason, but adventitious advantage resulting from better culture, is, perhaps, the only true reason, or that which accounts for both the others. Were equal care to be bestowed upon the best ex-

has been so long, so profusely, and so generally lavished upon two-rowed barley, in adaptations to soil, in hybridizing, and in selecting specially superior ears, scarcely a doubt can exist that eventual varieties might soon be obtained which would yield considerably greater produce than the best two-rowed kinds at present in cultivation, and at the same time be not one jot inferior in the sample.

The common English two-rowed barley was long a favourite variety; but has been so much ramified into subvarieties, and blended through the medium of these into other varieties, as to have, in a considerable degree, lost its distinctive character. Its ear, in general, is from three to four inches long, and about one-third of an inch broad; its grains amount to from twenty to forty in the ear, but in the best sorts usually amount to from twenty-eight to thirty, and are not very closely set on the rachis; and its awns extend about the length of the spike beyond its top. It is less prolific, and five or six days later, than bere; and it is less adapted for poor soils and elevated situations; but it is superior in quality, and is decidedly preferred by both the miller and the maltster. Its straw is not very long, and makes good winter fodder. Some subvarieties of it called long-eared, usually have from 24 to 40 grains in the spike; but they are comparatively weak in the culm, and are liable to be much laid by heavy rains, or overpowered by the weight of their own ear. A subvariety called the Moldavian was for some time in much favour; but it seems to have degenerated, or at all events was driven out of use by the discovery and diffusion of newer and better subvarieties. Some other subvarieties have run the same round, and shared the same fate as the Moldavian. A curious plant of common English barley was presented in straw to Lawson's Agricultural Museum in Edinburgh, by a gentleman in Fifeshire: it has three stems, two of them having ears of the usual form, and the other having a compound spike resembling that of Egyptian wheat, and containing 63 grains.

The Scotch, the Thanet, and the Lincoln barleys, though very frequently mentioned in the conversation of farmers and the writings of agriculturists, are mere subvarieties of the common English barley. The Scotch barley admits of great latitude in the time of sowing, and, though usually not sown later than the middle of May, has produced a satisfactory crop when sown so late as the 12th of June. But when late sown, its straw is liable to be soft, weak, and very easily lodged; though when sown early, the straw is as strong and resisting as that of most other barleys. The Scotch barley, previous to the introduction of the more fertile kinds which are at present in chief favour, was very highly esteemed by the best Scottish farmers, and was preferred by brewers and distillers to almost any barley grown from English seeds.—Ware barley, long well known in the south-eastern districts of Scotland

is simply Scotch barley grown two or three times upon land manured with sea-weed ; and it possesses an acquired habit of superior earliness, and, on that account, is in request for seed-corn by farmers in the later and more inland districts of the country.—Thanet barley so very closely resembles the Scotch as to appear the very same subvariety, a little modified by being sown for a number of years in a warmer climate. When sown early in the season on rich land, it possesses much strength and vigour, has a round and rather coarse grain, and yields a comparatively large produce ; but it seldom has a bright colour, and does not bring the best price in the market. Its grain is plump and thin-skinned, and is in request, far less for malting, than for pot-barley and barley-meal.—Lincoln barley is a late subvariety, with a coarse, ill-working grain, and suitable only for sharp soils and warm situations, where no better a sort of barley can be obtained. It was formerly sown upon land which had been summer fallowed ; but, since the introduction of better husbandry and improved rotations, it is not wanted, and has been driven almost entirely out of cultivation.

The Chevalier barley, as to its origin, is only a variation of the long-eared subvariety of the common English barley ; yet it possesses such distinctive characters as to constitute a well-defined variety of itself. Its ears resemble those of the common English barley, but usually contain two or four more grains in each ; its grains are rounder, much plumper, and contain a larger proportion of sugar ; its general character, for the purposes of both the miller and the maltster, is superior ; and its habit of tillering is so strong that a proportion of its seed-corn half a bushel per acre less than that of common English barley, will be equally productive. Yet it is eight or ten days later in ripening than common barley, and, on that account, is less suitable for cold soils and exposed situations. Its straw also is weaker and harder, and therefore more liable to be laid, and not so palatable to cattle. But, as a whole, it is a very valuable variety, and has, for a number of years past, been regarded with general and high favour throughout all the best agricultural districts of Great Britain. A gentleman of the name of Chevalier observed in his field an ear of barley of larger size and with plumper grain than he had ever before seen ; he carefully preserved it, sowed it in his garden, saved the seed, and re-sowed it, till he had a sufficient quantity for field-culture and general diffusion ; and he thus not only nursed and sent abroad the fine variety which bears his name, but practically taught all intelligent farmers the important lesson of how much profit may be acquired and how great good may be done by close and skilful observation. The Rev. Mr. Rham, who early put the excellence of this variety to the test, and lent his powerful aid to bring it into notice, said in 1833 or 1834, "That hitherto it has a decided

superiority over the common sorts, no one who has tried it fairly in well-prepared land seems to deny ; but unless great care be taken in cultivating picked parcels for seed, selecting the finest ears and plumpest grain, it will probably share the fate of its predecessors,—degenerate, and lose its reputation."

The Annat barley has grain of a bright yellow transparent colour, and observably more round and plump than even that of the Chevalier barley. "This new and seemingly very superior variety," said the Editor of the Quarterly Journal of Agriculture in 1835, "is the produce of three ears which were picked by Mr. Gorrie, Annat Gardens, in a field on the farm of Flawcraig, Carse of Gowrie, Perthshire, in the harvest of 1830 ; since which period it has been grown at Annat Gardens : hence its name. Last season it was sown on a ridge in the middle of a field with common barley on the one side and Chevalier on the other. In bulk of straw it seemed to have the advantage of both these kinds ; it was five days earlier ripe than the former, and about a fortnight before the latter ; and it was also 2½ lb. per bushel heavier than the Chevalier." This variety, however, requires a good soil ; and, judging from the peculiar situation in which it originated, it is not likely to possess near so wide a range of adaptation or to exert near so strong a resistance to deterioration as either the common or the Chevalier varieties.

The golden, Italian, or Alpine barley, was introduced not many years ago, from the Italian side of the Alps ; and is now somewhat extensively cultivated in Stirlingshire under the name of golden barley, and in Ayrshire under that of Italian or Alpine barley. Its ear is short, but very close, broad, and compact ; and its grains have a bright light yellow colour, and are larger than those of the common English barley. It appears to be a decidedly superior variety, and well worthy of cultivation.—Dunlop barley, though recently introduced, is pretty extensively cultivated in Perthshire and Forfarshire. Its ear and its grains are similar in shape and size to those of common English barley ; but, in common with the straw, are considerably darker in colour. It ripens about a week earlier than common barley, and, on that account, is adapted to exposed and elevated situations.—Chancellor barley is inferior, in aggregate qualities, to some of the preceding varieties. Its ear is rather long ; but its grains are not very closely set.—Royston barley also is inferior, and darker in colour ; and its grains, though large, are rather widely set.—Stain's barley has a slender ear, and is tolerably good in quality. It is sometimes called Siberian barley ; but this name, as already shown, properly belongs to the naked six-rowed barley. The principal other varieties of common two-rowed barley, at present known in Great Britain, are Norfolk spring barley, Black's superlative barley, Brown's barley, Bute barley, Lord Western's barley, Not-

tingham long-eared barley, Ospisdale barley, Potter's barley, Providence barley, and Suffolk short-necked barley. Specimens of all these varieties have been deposited in the Museum of the Highland Society.

Two-rowed black barley has so very marked a character as to be treated sometimes as a permanent variety under the name of *Hordeum distichon nigrum*, and sometimes as a quite distinct species under the name of *Hordeum nigrum*; yet the latter of these names belongs just as fully to the six-rowed black barley, and is therefore of doubtful application. Two-rowed black barley is prolific in both quantity of grain and bulk of straw, but does not ripen till six or eight days after the common English barley. Its grains are large, coarse in shape, and black or dark-blue in colour.—The Cape of Good Hope barley is closely allied to the two-rowed black barley, but has its grains more closely arranged in the spike, and its barren florets of a whitish colour.

Two-rowed naked barley is sometimes treated as a permanent variety under the name of *Hordeum distichon nudum*, but more frequently and more correctly as a distinct species under the name of *Hordeum nudum*. Its ear is long; and the grains of each usually amount to twenty-eight or thirty, are very large, and separate from the paleæ or chaff in the same manner as wheat. One sort of it is believed by some botanists to be so decidedly specific in its awn-shedding character as to be fully entitled to the specific name *Hordeum nudum*, while another sort is so far capable of losing that character as to be properly a variety of common two-rowed barley, under the name of *Hordeum distichon imberbe*. But sub-varieties of it, of slightly different character, and obtained from mutually independent sources, have at several periods been brought into cultivation under different names, and all driven out of favour. Miller says, "There was cultivated to a considerable extent in Staffordshire, about sixty or seventy years since, under the name of *Triticum speltum*, a sort of naked barley or wheat barley, the ear shaped like barley but the grain like wheat; and it made good bread and good malt, and yielded a good increase." But, upwards of half a century ago, this *Triticum speltum* appears to have passed out of cultivation into total oblivion. "About seven or eight years since," said Mr. Lawson in 1836, "Mr. Loudon introduced two-rowed naked barley from the north of Europe, under the name of Siberian barley, and distributed it among several cultivators in various parts of Britain. One portion, consisting of about 50 grains, which he sent to Mr. Gorrie, Annat Gardens, Perthshire, and which was sown in the garden, yielded a considerable return of grain, and ripened early; but on its cultivation being extended to the field, its straw was found to become very brittle and tender towards the period of ripening, so as to be unfit for supporting the ears, and completely incapable of forming

into ropes for binding. Its cultivation was therefore abandoned. The grain, however, on being ground, yielded a good barley-flour; and had it not been for the above-mentioned circumstance, it might have been cultivated with advantage for that purpose."—The only other species of cereal barley known to us are a rye-like species, *Hordeum secalinum*, mentioned in writings of nearly a century and a half old, and the flattened species, *Hordeum complanatum*, introduced to Great Britain from the south of Europe about 25 or 26 years ago.

Cultivation of Barley.—In the rotation of crops, barley may follow either a summer fallow, potatoes, turnips, pulse, or any forage or herbage crop. An universal practice, during the immature or transition period of modern husbandry, was to sow wheat after a summer fallow, and barley after wheat; but this practice entailed the wasteful necessity of another fallow after the barley; and it was first modified by sowing clover with the wheat, and either dispensing with the barley or assigning it a later place in a longer rotation; and was afterwards pretty generally abolished, by sowing barley with clover after the summer fallow, and sowing wheat after the clover. Yet in some peculiar circumstances, when the soil is a very friable loam, when the autumn is unusually dry, when wheat stubble can be ploughed and reduced to a fine clean tilth before the commencement of close winter weather, and when several ploughings and harrowings can be given in spring, barley may, even in the present highly improved state of husbandry, advantageously follow wheat; yet these circumstances are of comparatively rare concurrence, and ought in no case to be further calculated on than as affording an excellent and profitable opportunity of arresting or preventing the deterioration of land which always, in some degree, results from a long and unvarying routine of even the best rotation. In most cases, too, in which barley can judiciously be made to follow wheat, the land cannot be sufficiently freed from the seeds and roots of weeds to be fit for an accompanying sowing of clover and grass seeds; so that in such cases, the barley ought to be sown alone.

When barley profitably follows a summer fallow, the soil is strong, comparatively adhesive, much fitter for wheat than for turnips, so firm and compact that if a crop of turnips upon it were fed off by sheep, or removed with carts, it would be most mischievously consolidated during winter by the tread of the sheep's feet or the pressure of the carts' wheels. Land of this kind, though highly fertile under suitable mechanical conditions, cannot without much labour and tact be brought into a sufficiently pulverulent and porous state for the luxuriant or even healthy growth of barley; and, therefore, in various districts, particularly in Essex and Suffolk, it is subjected to a fallow of 18 months, from harvest till the second spring, in order that it may be

perfectly cleaned, and rendered thoroughly porous, powdery, and mellow, by the tillage of autumn, the frosts of two winters, and the ploughings, scarifyings, and harrowings of a summer and two springs. Though the loss of time and the expenditure of labour by such a fallow are great, yet they are, in general, well compensated by the produce of the subsequent crops. The land is completely divested of weeds; the barley finds ready access to the nourishment in the soil, and obtains that nourishment without competition from noxious herbage; the clover sown along with the barley obtains ample possession of the ground, and contributes the most effective preparation for wheat; the crop of wheat, if the tillage be in keeping with that of the commencing fallow, will be luxuriant; a well manured and a diligently hoed crop of beans may follow the wheat; and a second crop of wheat may be interposed between the beans and a repetition of the fallow. Any clever, calculating farmer will see, almost at a glance, that a rotation like this, beginning with barley and including two crops of wheat, is likely, even with all the deduction of the long fallow, to afford quite as good a remuneration, as a rotation of a different and shorter kind, beginning with wheat after the ordinary turnip or summer fallow. The long fallow followed by barley, however, must be understood as appropriate only upon the kind of soil which we have indicated, and as most wastefully unsuited to soils of a lighter and more prevalent description. When, in any case, barley follows an ordinary summer fallow, the land is ridged up in the same manner as for wheat, is left in that condition till spring, and is either thrown into seed-furrow, or stirred and pulverized with the grubber immediately before sowing.

Barley is seldom sown after potatoes; for wheat, at that stage of a rotation, is, in all ordinary circumstances, quite as suitable, and is preferred on account of its superior value. But when, in any case, barley does succeed potatoes, the land is treated in nearly the same manner as when this crop succeeds a summer fallow.—When barley is sown after beans or pease, the land, after these are removed, receives one or more ploughings; it is then ridged up so as to lie dry and become pulverized during winter; and it receives one or more ploughings or grubbing in spring, immediately before sowing. But wheat far oftener and more appropriately succeeds beans, both because it is a more valuable crop than barley, and because it and beans have a preference for the same kinds of soil.

In all the places of a rotation which we have mentioned—after a fallow, after potatoes, and after pulse, winter barley, except on tenacious soils or in wet autumns, might as appropriately be sown as spring barley; and, in accordance with a statement which we made when generally comparing the two kinds, the winter barley might very advantageously be pre-

ferred. The mode of preparation for it is the same as for winter wheat, with the difference that every appliance must be used to bring the soil into a thoroughly porous and powdery condition, and to have it both dry and freshly stirred at the time of sowing.—The bere of Highland districts, when sown as spring barley, ought if possible to have the same tilth and the same place in rotation as the two-rowed spring barley of England and Lowland Scotland; but as the preparation for it is generally effected by digging, and cannot in numerous instances be effected with horse-drawn implements, the main points to be attended to are, that the instrument employed be an actual spade, and not some miserable apology for one, and that this instrument be so handled as to destroy all perennial weeds and reduce the soil to a fine powder.

The grand place for barley, in almost every kind of rotation, and upon all soils of medium character for lightness, or even upon soils which verge close upon the extremes of tenacity and sandiness, is after turnips, and in accompaniment with a sowing of clover and grass seeds. This principle is universally admitted in the present improved British husbandry, and is generally acted upon in all the best barley districts of both England and Scotland. Yet the preparation for barley after turnips is not quite the same in England as in Scotland, and requires to be considerably modified in adaptation to different soils. Barley yields a tolerably fair produce upon light sandy lands, which are too poor to nourish wheat; it yields not a bad produce upon half moorish lands, whose soil is somewhat pulverulent; it succeeds with difficulty, and makes wretched returns, upon any land which is adhesive, retentive, compact, and badly aerated; it thrives pretty well upon clayey lands which lie dry, and have been considerably commixed and rendered mechanically porous, with ashy and calcareous manures; it is luxuriant on good light dry land, such as rich black mould; and, in general, it makes its best returns upon lands of any kind which are chemically fertile and mechanically dry and powdery, or, in other words, which are rich in manurial elements and finely pulverized by thorough and skilful tillage. Yet both turnips and barley are necessarily grown upon soils of widely different character, varying from the tenacious clay to the almost drifting sand; and any reflecting person will therefore see at a glance that preparation for barley must be modified always by the nature of the soil, and sometimes by the comparative wetness or dryness of the season.

In very light soils, such as those of a large proportion of the turnip lands of Norfolk, Suffolk, and Essex, a chief part of the preparation for barley, is effected simply by the processes of cultivating the turnips, and feeding them off with sheep. "When the land has been properly prepared for turnips, and well manured, and the

turnips have been carefully hoed, so that no weeds of any kind remain, it is then in the finest state for barley as soon as the turnips are off. Turnips require a well pulverized soil, and so does barley. If the soil is very dry and light, the sheep folded upon it consolidate the surface by their treading, and enrich it by their urine and dung. As soon as a part of the field is cleared, and the hurdles removed, the land is ploughed with a shallow furrow, and thus the sheep and the ploughs are often seen in the same field succeeding each other, that no time may be lost in turning in and covering the dung, which is very volatile, and would soon lose much of its qualities by the action of the sun and winds. This is sufficient preparation for the seed, which may now be sown or drilled without delay."—*[Rham's Dictionary of the Farm.]* The improvement made upon the soil by the excrements of the sheep and the contact of their bodies, is called in Norfolk 'the teathe;' and the ploughing in of this, as closely as possible to the flocks, is called the 'sealing' of it.

The old method of treating all land in Norfolk and Suffolk, after clearing it of turnips either by sheep-feeding or by carting-off, was to plough it once, twice, or thrice, for either barley or any other kind of seed-corn,—the ordinary farmers ploughing once, the better farmers twice, and the best ploughing thrice. On very dry soils, this method incurred no farther disadvantages than useless waste of labour, and partial dissipation of the volatile portions of the sheep's urine; but upon soils of a stiffer kind it turned down the surface which had been pulverized by the frosts of winter, and brought up the adhesive, cloddy, bottom soil, which had not been duly influenced by either the frosts, the air, or the ammoniacal manure. "Those who are used to attend to the effects of tillage on different soils," remarks Mr. Arthur Young, "know well that loam and clays of various degrees of tenacity, if they have been properly formed into lands for winter, and not poached by horses trampling, receive the frosts to advantage, and are found with a friable surface in the spring. If rain comes, it dries, and leaves the surface still in good order, and ready for any operation. But plough such lands, and turn up the more adhesive bottom, not acted upon by frost, and let rain fall on such fresh-turned furrows, it remains stiff and soddened, it does not become porous again, the air cannot get into it, and if drying sharp winds at north-east follow, the furrows become longitudinal slices of clod, very difficult to be acted upon by any instrument, and the farmer finds himself in a most unpleasant situation. He no more recovers a fine friable surface; and it becomes twenty to one whether he has a good crop." The new practice, which began to be adopted about fifty years past, was to employ the scarifier instead of the plough, and in consequence to loosen, pulverize, and aerate the land without turning down

its surface. The scarifier has been of different breadth and different forms, according to the progress of improvement; but, in general, it has stirred the soil to the depth of from four to six inches, and has been drawn by horses walking only in the furrows, and not trampling the prepared land. In some cases, one scarifying and two harrowings are given; in other cases, two scarifyings and three harrowings; and, in other cases, two scarifyings with small tines, one scarifying with large tines, and a proportionate degree of harrowing. The amount and the modification of the work are entirely dependent on the comparative tenacity or consolidation of the soil, and can be readily determined by the look and tread of the experienced farmer. The operations are speedily performed; they put the stitches or ridges into excellent order for the immediate reception of the seed-corn; and they are much less liable to be surprised and defeated by unfavourable weather than the slower and more critical operation of ploughing.

On lands which are decidedly cohesive, however, whether in consequence of their own nature, or from the effects of some temporary consolidation, ploughing may be indispensable for breaking the masses of the soil into minor fragments. Even Mr. Arthur Young says, "Upon all clays, and loams of any degree of tenacity, which have been sheep-fed lately, the surface may be firm and trodden. The degree will depend upon the weather that has taken place, whether wet or dry; but if the farmer has a strong and heavy hoe in his hand, or a spade, he will easily perceive whether or not the temper of the surface will let the scarifier work effectually. If this tool works well, or is likely to work well by the 20th of March, its use should preclude the plough; but if, from the state of the surface, compared with that of the soil at the depth of five inches, it appears that a ploughing is really necessary, the prudent farmer will of course give it." The general practice in Scotland is to perform the whole tilth, on all sorts of land, by turning down the surface with the plough, and, when necessary, to make a free subsequent use of the harrows and the roller. Though the scarifier or grubber is now well appreciated and freely used in the husbandry of some of the best farmers, still the plough continues to be the characteristic implement of preparation for barley after turnips. This apparent weddedness to old practice is greatly modified by improvements in the construction of the plough, and by the use of different kinds of ploughs in adaptation to different soils and circumstances; and, so far as it is not thus modified, it is in a great measure, if not wholly, accounted for by the prevailing stiffness and comparative wetness of soils, and by the superior execution, the diversified manner, and the highly improved character of the general style of ploughing. Sir John Sinclair's Report for all Scotland, published in 1814, says, "After turnips or pulse,

barley is sown with one ploughing only, and as quickly afterwards as possible, upon what is termed hot-fur, so as not to allow time for the newly turned up soil to lose its sap. When, however, these soils happen to turn up very coarse and cloddy, it is sometimes judged proper to harrow and roll the land, and to give a second or even a third ploughing, to reduce the soil to good tilth. This is often more especially necessary on the land where the last of the turnip crop has been consumed, when a considerable drought has set in after the surface has been much trampled upon in consuming the turnips, by which the soil becomes so hardened and consolidated, as to require the industrious use of the plough, harrows, and roller, to render it proper for receiving the barley seed, which if possible ought always to be sown on a fine tilth." Be the precise implements and the precise methods what they may, the soil must be reduced to a state of comparatively dry powder, else barley ought not to be sown; and should weather or other circumstances be unfavourable, let the farmer rather postpone the sowing to the latest possible period, than deposit the seed upon waxy, cloddy, or ill-pulverized ground. See the articles GRUBBER, PLOUGH, and TILLAGE.

In well managed farms, the only manuring for barley is the amelioration of the soil by the preceding turnip crop being fed off with sheep. Yet when the turnips require to be carted off, and the land is in a somewhat exhausted condition, a good dressing of well-fermented spit-dung, in a state of thorough decomposition, may be given. In districts near the coast, sea-weed, when abundant and easily obtained, is sometimes very efficiently applied as a top-dressing after the barley has germinated and appeared above ground; and this appliance is, of course, especially useful when the turnips have not been consumed upon the field. Soot was formerly given in some parts of England as a top-dressing after germination, but not with good effect. A common custom, in former times also, was to sprinkle malt dust upon newly sown fields, in the proportion of about forty bushels per acre. In the higher parts of Scotland, lands which have been fallowed in preparation for bere, are sometimes manured in the same manner as for turnips; yet even in these districts, the method, now almost universal in England and Lowland Scotland, is practised of giving no manure to barley except indirectly through a preceding crop of turnips. In the old Scottish system of husbandry, when the best of the 'infields' or home lands were under a continual course of cropping, the whole farm manure was applied to one-third of the infield for a crop of barley. This division of the infield received three or more ploughings, or a kind of bastard spring fallow; and the other two divisions were under either oats or pease. As the outfield never received any manure, and contributed the whole of its straw to the farm-yard, an ample quantity of

manure was always available for the barley break. But the whole of the barbarous system of infield and outfield, together with its appropriation of all the manure of the farm to barley, oats, and pease on the home lands, can now be found only in the worst parts of the Highlands and Islands, and is steadily in the course of extermination from even its fastnesses among the mountains and on the islands.

Barley may be sown at any time, according to soil, climate, situation, and weather, from the early part of March till the end of May. The best practical rule is to sow as early after the middle of March as the ground is dry, and a prospect exists of a day or two's drought; and to postpone sowing till May, so long as the ground is wet and the weather unsettled. The soil can scarcely be too dry at the time of receiving the seed; and, if it afterwards obtain the moisture of only two or three showers to promote vegetation, it can produce a good crop though it should continue dry throughout the summer. Barley has been known to germinate, grow, and ripen, without receiving so much as one shower from the time of sowing till that of reaping; and, on the other hand, the fall of a single shower upon a field of strong soil, immediately after being sown with barley, will burst and otherwise kill a large proportion of the seeds, and inevitably cause the crop to be thin. In general, early-sown barley, when the soil and the weather are dry, tillers better and produces a heavier crop of grain than late-sown barley. On strong lands, in particular, late-sown barley is liable to tiller badly, to rush up into long and feeble culms, and, in consequence, to be easily laid and subjected to discolouration and waste; while, on weak lands, it will fail to possess even tolerably large culms, and will yield both a small and a comparatively bad harvest of both straw and grain. Yet, in some seasons, early sown barley is liable to be very seriously injured by smart frosts or heavy rains; and late-sown barley obtains favourable weather, and produces much the better crop. Discrimination, indeed, must be freely and wisely exercised, not alone as regards the state of the soil and the weather, but as regards the climate, the quality of the soil, and the late or early habits of the species or variety of the grain. Cold and poor soils require to be sown earlier than warm and rich soils; and late varieties of barley, other circumstances being equal, require to be sown earlier than early varieties.

Barley may be sown either broadcast or by the drill. If sown broadcast, every handful, in order to effect regularity of dispersion upon the inelastic surface of the finely pulverized soil, requires to be cast with considerably greater force than is requisite for any other sort of grain; and in order that the sower may not be exhausted with fatigue, and may possess the best grasp of the plump and slippery seed-corn, he ought to walk in short steps, and sow in small handfuls. But sowing by

the drill is better adapted for the light soils on which barley is generally grown, ensures a more equable distribution of the seed, and affords far superior facility for a subsequent undisturbing sowing of clover and grass seeds. The most usual distance of the drill-rows is eight inches in light soils, and nine inches in heavier soils.—Winter barley requires to be but slightly covered, and very freely tillers in ordinarily good land. Spring barley ought to be deposited at the depth of from one and a half to three inches, according to the nature of the soil and the circumstances of the season; for if deposited at less depth, it will probably not sprout well, and may not become sufficiently anchored by the roots to resist the dangers of being laid. An uniform depth of all seeds in the same field is requisite for securing an uniform shoot in germination, and an uniform forwardness in ripening; for when the depth is irregular and various, some plants rise to the surface earlier than others, and some will be ready to shed their seed from over-ripeness before others have parted with their hue of greenness.

The usual quantity of seed sown is from 2½ to 4 bushels per acre broadcast, and not exceeding two bushels in drill. But the quantity, whatever might be pronounced its normal amount, ought always to be modified by considerations of the species or variety of the seed, the character of the land, and the comparative earliness or lateness of the time of sowing. Some varieties of spring barley, inclusive of several of the most esteemed kinds, have a powerful habit of tillering, and, if sown as thick as the kinds which tiller less, will grow up in a half smothered and weakly condition. The qualities of land best adapted to barley, and most opulent in the elements of fertility, may require, in any given circumstances, only ten pecks of seed, broadcast, when land of medium qualities would require twelve, and land of the poorest qualities would require fourteen or even sixteen. Any land, also, when sown late in the season, requires more seed than when sown early; for, in consequence of the rapid growth of barley, the increase by tillering is considerably less from late sowing than from early sowing. Yet some agriculturists—contrary to both the theory and the practice of others—contend that barley ought, in all circumstances, to be sown pretty thick, and without any reference to its increase by tillering. Mr. Brown, for example, says, "Little argument is necessary to prove, that thin sowing of barley must be attended with considerable disadvantage; for, if the early part of the season be dry, the plants will not only be stunted in their growth, but will not send out offsets; and if rain afterwards falls, an occurrence that must take place some time during the summer, often at a late period of it, the plants then begin to stool, and send out a number of young shoots. These young shoots, unless under very favourable circumstances, cannot be

expected to arrive at maturity; or if their ripening is waited for, there will be great risk of losing the early part of the crop,—a circumstance that frequently happens. In almost every instance, an unequal sample is produced, and the grain is for the most part of inferior quality. By good judges it is thought preferable to sow a quantity of seed sufficient to ensure a full crop, without depending on its sending out offsets. Indeed, when that is done, few offsets are produced, the crop grows and ripens equally, and the grain is uniformly good."

The sowing of the seeds of clovers and grasses with barley is an almost universal practice in Great Britain, and is generally esteemed one of the greatest improvements in the modern husbandry of rotations. This sowing may take place either at the same time as the barley, or after the latter has appeared above ground. When the barley is sown either with or without clover and grass seeds, a light rolling is given, to press the soil into thorough contact with the seed, and to prevent too rapid an evaporation of moisture; and when the plants have sprung and are beginning to tiller, another rolling is given, and sometimes also a slight harrowing, to make a gentle stirring of the surface for aeration, and to thin out any excess or overcrowding of the shoots. When the clover and grass seeds are sown at the same time as the barley, they are sown immediately previous to the last turn of the harrow, and are settled in their place by that turn of harrowing and by the rolling; or they may be sown after the harrowing, and settled solely by the rolling. When not sown till the barley is above ground, they are sown immediately before the second rolling, and are settled by it in the soil. Should heavy rain occur between the sowing of the barley and the time of its expected appearance above the surface, a crust or skin will be formed by it so persistent as not to be easily penetrable by the young plants; and this must be destroyed by a gentle harrowing as soon as the land is dry. When a harrowing is given in dry weather after sowing, it ought to be given very cautiously, and with very light wooden-teethed harrows; for if performed in the ordinary way, it is not a little liable to break, tear, and eradicate the plants to such a degree as to do vastly more harm than good. Hoeing barley-land ought never to be requisite for the purposes of weeding or cleaning; but when resorted to on drilled barley land as a better method of loosening the soil than harrowing, it forms a good preparation for the sowing of the clover and grass seeds. After the last rolling is given, and the water furrows and drains are cleaned out, the processes of cultivating barley ought to be in a state of completion till harvest. Yet if weeds should appear, they must, at any reasonable amount of expense, be immediately pulled up by hand; for, if not promptly extirpated, they will take firm possession of their site, and retain

it throughout the whole subsequent growths of the clover and grasses. For this reason, but especially for reasons of far greater importance, the practice of sowing clover and grasses with barley, is not quite so superlatively excellent as to be above the reach of doubt or question. The clover and grasses sustain to the barley the relation of weeds; and, as such, they rob it of part of its nourishment, and interfere with the freeness of its tillering; and though they possess far less of this objectionable character, when sown after the barley is above ground than when sown at the same time as itself, yet in the latter case the clover incurs some risk of being seriously curbed or even altogether smothered. In some seasons, the clover is so very luxuriant as materially to injure the barley; and in wet seasons, it so mixes its succulent stems with those of the barley at reaping, as to render it difficult to dry the barley in the field or to prevent it from heating in the stack. The grand uses of sowing clover and grasses with the barley are to obtain a profitable and improving crop after the barley without further tillage, and to make an easy and most effective preparation for wheat; and certainly these uses are so very rich as to bear the deduction of some little loss from the weight of barley. In sandy soils in Flanders, a white carrot is sown along with barley; and after the latter is cut down, the ground is thoroughly harrowed, and sprinkled with liquid manure. The carrots make exceedingly little growth of stem or leaf while the barley is growing, and can scarcely be observed when it is cut down; yet they afterwards grow with rapidity, and become a good crop before the commencement of winter; and they are found to be of great value for feeding swine, and for causing large secretions of urine in black cattle.

Weeds.—One principal weed which infests barley fields is the corn or way thistle, *Cirsium arvense*; it is perennial, has creeping roots, takes possession of a comparatively large spot of ground, and usually grows to the height of about two feet; and it ought to be pulled up by hand as soon as it appears, or cut down with a weed-hook between the time of its being 9 inches high and of its passing into flower; for if not promptly destroyed, it not only acts detrimentally on the plants immediately around it, but wafts its plumed seeds over a large extent of circumjacent ground. Another chief pest is the annual corn charlock, *Sinapis arvensis*; it is especially troublesome when street or police manure has been used; and it ought to be pulled up by hand when the barley is broadcast, and hoed up when the barley is in drills. Two other principal weeds are the pretty annuals, the doubtful poppy and the common corn poppy, *Papaver dubium* and *Papaver rhæas*. The deep scarlet flower of the latter, in particular, has a remarkable and brilliant appearance, and may sometimes be seen at a great distance, but never reflects any credit upon the

condition of the tillage. Another considerable annoyance is the cleavers or sticking-grass, *Galium aparine*; it is a climbing annual, of the bed-straw kind, growing to the height of about three feet; and its seed is exceedingly hard, and does not become softened, but feels almost like a minute stone, after having been boiled with pot-barley.

Harvesting.—In even the best seasons, barley requires more care in reaping and harvesting than any other grain: and in unfavourable seasons, it sometimes cannot be secured in tolerable condition without great labour and exceeding difficulty. When fully ripe, its straw is extremely brittle, and its ears are very liable to break off in handling; so that it ought to be cut down while the straw retains a considerable proportion of sap, and before the grain has lost all its pulpy softness. The best marks of due ripeness for reaping are a bright golden colour in the straw, from the bottom to the middle or upper part of the stem, and the disappearance of the purple hue, the appearance of a light straw colour, and the inclination to a slightly drooping position in the ears. If a skilful farmer walk through a field of ripening barley, select a few of the greenest heads, and finds that the grain of these can be separated from the chaff by rubbing them between his hands, he knows that even these greenest grains are out of their milky state, and that the whole crop ought immediately to be reaped. Greenness in the upper part of the straw is of no consequence; for if the lower part of the straw be quite yellow, all nourishing or maturing communication from the soil is ended, and the whole plant is truly and healthily ripe. Yet thorough care must be used not to cut the crop a moment before true ripeness is attained; for the increase of value during the three weeks preceding real maturity amounts to nearly one half of the entire produce, and the increase during the last five or six days amounts to about four or five per cent.

Barley is very generally cut in England with a cradle scythe, and is deposited by that instrument in a regular swathe. But when a sufficient number of labourers, at reasonable wages, can be obtained, it is much more profitably cut with the Hainault scythe, or even with the common sickle or reaping-hook. The latter instrument, till of late, was the only one used in reaping barley in Scotland; but the Hainault scythe, after a little practice, and in the hands of an expert reaper, cuts down, in any given space of time, a much larger quantity than the sickle can cut. See the articles SCYTHE, HAINAULT SCYTHE, MOWING, and REAPING. A common practice in England is to rake the swathes into heaps; but this frequently occasions the shedding of as much seed as would suffice for re-sowing the field. The binding of the barley into sheaves, and the placing of these sheaves in hooded stooks, not only prevents this great waste by shedding, but affords a better protection from the effect of rains, and presents a far less expo-

sure of the grains to the depredations of birds. Mr. Arthur Young—speaking without particular reference, yet so that he must be understood as referring to the barley harvest of Norfolk, Suffolk, and similar districts—says, “The barley crops should generally have good field room, lying five or six days after mowing. They will improve; and if a heavy shower of rain comes, it will not diminish the farmer’s profit; it will make the grain swell and measure more per acre; for maltsters reckon much on their profit in such dry harvests that the barleys receive no rain after they are mown.” This practice, however, if not conducted within rigid limits, would be a perilous one in most seasons in Scotland, in Ireland, or in the north of England, and must not be carried to an intrepid length in even the driest parts of eastern and southern England. Hence even Mr. Young adds, “While barley lies in the swathe, if much rain comes, it is apt to sprout. In the wet harvest of 1801, this crop in Norfolk presented a most melancholy spectacle. Three or four wet and very warm days made it grow to such a degree, that when the swathes came to be turned, they looked as if feathers had been strewed along every swathe. Many thousand acres were thus damaged. Those farmers escaped best who ‘lifted’ the swathes before they were dry enough to turn; they raised them lightly from the ground with forks to let air in,—a practice worth recommending.” The greatest antagonist which British barley has, in fact, is the moisture of our climate; and the main care of a wise farmer, throughout the entire treatment of barley, from the sowing till the complete securing of it, is to protect it from this antagonist. So exceedingly apt is barley to sprout, under even a brief duration of moisture, especially when the temperature is above 45° or even 40°, that ears of it may sometimes be seen in full germination actually before the crop is reaped; and sprouted barley, even when its further vegetation is checked by dry weather or by the kiln, is so exceedingly deteriorated in quality as to be fit only for feeding poultry and swine. When reaped in showery or humid weather, it ought to be gathered into single sheaves slightly bound near the end, and set upon their spread-out butts; and when such sheaves are ready to be carried, they should be rebound in the manner of ordinary sheaves. When the crop is mown, it ought to lie no longer in the swathe than till moderately dry; and it ought then to be gathered into sheaves and stooked. The crop should remain in stooks till the grain is completely hardened, and the straw perfectly freed from natural sap; else it will be exceedingly apt to heat in the stack. The risk of heating is, in almost any case, considerable; yet it may be entirely avoided by letting the crop completely dry before removal, and by storing its stacks with open frames, bosses, or cages through their centre, and duly thatched with straw. See the articles **STACK**, **FARM**, and **HARVEST**.

Thrashing.—Barley will keep well unthrashed for a year; and when intended for malt, it may be kept till the second spring; but if kept longer than eighteen months, or at the utmost two years, it is almost certain to be overrun and destroyed by insects. On account both of the awn-ness of its grains, and the texture of its straw, it requires more care in thrashing than any other cereal crop. When it has been mown, all the straw, independently of the necessity of separating the awns, requires to be twice thrashed; and whether mown or otherwise reaped, the grains must undergo an additional process to ordinary thrashing in order to be freed from their awns. This additional process is called hummeling; and the contrivance for effecting it is called a hummeler. See the article **HUMMELER**.

Produce.—The produce of barley in England is said to vary from 15 to 75 bushels per acre. The average produce in Middlesex has been estimated at about four quarters per acre; in England and the south of Scotland, at 32 bushels; and in all England, all Scotland, and Wales, at 28 bushels. The ordinary produce of good varieties, on good soil, and under good culture, is from 30 to 50 bushels per acre, and from 45 lbs. to 58 lbs. weight per bushel; but this quantity is sometimes, in the most favourable concurrence of circumstances, considerably exceeded; it is always liable to some modification from causes over which a farmer has little or no control; it is mainly affected by the quality of soil, climate, weather, tillage, and sowing; and it is, in no inconsiderable degree, modified by the particular variety of the seed. The weight per bushel of some of the best varieties, according to specimens deposited in the Highland Society’s Museum, is of common two-rowed English barley 54 lbs.,—of Chevalier, 54½, 56½, and 58 lbs.,—of Annat, 54½ and 57 lbs.,—and of Dunlop, 53½ lbs.

Diseases.—The diseases to which barley is subject, are fewer and less virulent than those which attack wheat. It is sometimes affected by smut, principally from the minute but now well-known fungus called *Uredo segetum*. See the article **URED**O. It is preyed upon by the larvæ of several insects, especially by those of a small moth called *Tinea hordei*. From 20 to 30 eggs of this fly are deposited in one grain of thrashed or stored barley; and each of the larvæ, when hatched, selects a grain for itself, bores its way into the interior, and there lies concealed. When the *Tinea hordei* is timeously observed in a granary, it may be exterminated by spreading out for it a few handfuls of the barley, carefully covering all the rest of the unattacked grain, and roasting or destroying the decayed handfuls after they have received the insects’ eggs, and before these have time to be hatched. An insect, hitherto either not at all or confusedly described, sometimes attacks and materially damages the growing crop. Mr. Crisp of Rugby, near Alnwick, says respect-

ing it, in the 58th No. of the Quarterly Journal of Agriculture, "It is now several years since a neighbour directed my attention to a great defect in his barley crop, which was apparently caused by the ravages of some insect in the larva state living in the sheath, and feeding upon the ear previous to its appearance from the shot-blade, which, like nearly all the injuries of insects in the embryo state, goes by the designation of grubbing. Every year I have observed more or less injury to the crop by the same cause; but it appears most serious in a late or wet cold year upon stiff soils. At the time when I gathered specimens of it, the healthy plants were shot and at full growth; the attack of the insect must, therefore, prevent all these stalks from yielding any grain; and that such is the case, I can testify by my experience at the harvest. The injury appears to be caused by the larvæ feeding upon the internal parts of the plant in its earliest state; and the transformations are made within the shot-blade."

Analysis.—An analysis of the grains of Norfolk barley, but without any specification of the variety of the plant or of the circumstances of its culture, was made by Sir Humphrey Davy, and resulted in 79 per cent. of mucilage or starch, 7 per cent. of saccharine matter, and 6 per cent. of gluten or albumen. An analysis of ripe grains of barley by the German chemist, Einhof, resulted in 70.05 per cent. of meal, 18.75 per cent. of husk, and 11.20 per cent. of water; and an analysis of the meal resulted in 67.18 per cent. of starch, 5.21 per cent. of uncrystallizable sugar, 4.62 per cent. of gum, 3.52 per cent. of gluten, 1.15 per cent. of albumen, 0.24 per cent. of superphosphate of lime, and 10.79 per cent. of water and loss. An analysis of unmalted grains of barley by Proust, resulted in 1 per cent. of resin, 4 of gum, 5 of sugar, 3 of gluten, 32 of starch, and 55 of hordein; and a corresponding analysis of malted barley resulted in 1 per cent. of resin, 15 of gum, 15 of sugar, 1 of gluten, 56 of starch, and 12 of hordein. The principle or substance which Proust designates hordein, which has been regarded as the characteristic principle of barley, and which would appear from Proust's analysis to play a main part in the seed's germination, and to be chiefly transmuted by germination into starch, gum, and sugar, will be noticed in its own alphabetical place. See HORDEIN. The incineration of barley grain with its skin was ascertained by Saussure to yield 18 per cent. of ashes, and the incineration of barley straw to yield 4½ per cent. An analysis of the ashes of the grain, by the same distinguished chemist, resulted in 18 per cent. of potash, 9.2 of phosphate of potash, 1.5 of sulphate of potash, 0.25 of muriate of potash, 32.5 of earthy phosphates, 35.5 of silica, 0.25 of metallic oxides, and 2.8 of loss.

Uses.—One great and too often a principal use made of the grain of barley in Great Britain, and in other non-vinous countries, is to convert it

into malt for beer, ale, and other fermented intoxicating drinks. A similar but not so general use is malting for the distillation of alcoholic liquors. The best and heaviest grain is usually selected for both of these purposes; and portions of the finest agricultural districts are employed in its cultivation. The number of bushels of malt charged with duty in the United Kingdom in 1821 was 29,393,441; and the amount of duty paid thereon, £5,297,389. In 1845, duty was paid on 36,545,990 bushels; the amount of duty being £4,937,958. See the article MALT. A third, but far different and altogether desirable use is for human food, in the form of either barley-meal, or decorticated barley,—the latter usually called pot and pearl barley, and variously used for soups, broths, and puddings. Inferior or half-spoiled barley is generally used for the feeding of poultry, pigs, and cattle. Green or growing barley, or the whole plant in its unripened state, particularly the Siberian six-rowed barley, is excellent spring food for milk cows, becomes available at an early period of the season, occasions a large secretion or flow of milk, and is highly appreciated by the dairymen in the vicinity of London. It is also very suitable for horses; it serves both as a nourishing food, for increasing their flesh and improving their condition, and as an excellent spring physic, for gently cleaning their intestines; but it must at first be given in small quantity, else it will act as a smart purgative. It is more nourishing and earlier available for sheep than rye; and when fed off to the surface in April, will spring again, and, under fair circumstances, produce a good crop of grain in August. Decoctions of the prepared grain are serviceable during many kinds of disease in the human subject; they are particularly useful in all pulmonary complaints; and, when acidulated with the juice of lemon or any similar vegetable acid, they are cooling, gently nourishing, and extremely grateful in fevers.

The straw of barley, in favourable circumstances, is suitable fodder for cattle; but, in general, it is serviceable chiefly as litter; and in no case can it be eaten by horses without producing some tendency to disease. It is always soft and somewhat clammy; and when newly thrashed, it has a heavy disagreeable odour. Even for litter, it is neither so cleanly, durable, nor comfortable as wheat-straw; and for thatch, it is too soft, too difficult of assortment into lengths, too pervious by rain, and too liable to rot. Barley chaff is readily eaten by both old and young cattle, and never injures their mouths with its awns; but it soon heats in the chaff-house, and cannot, without considerable care and labour, be long kept from fermentation.—*The Farmer's Magazine.*—*Quarterly Journal of Agriculture.*—*Elliot's Field Husbandry.*—*Mortimer's Husbandry.*—*Mill's Husbandry.*—*Lisle's Husbandry.*—*Knowledge Society's British Husbandry.*—*Doyle's Practical Husbandry.*—*Sproule's Treatise*

on Agriculture.—*Du Hamel's Husbandry*.—*Museum Rusticum*.—*Miller's Gardener's Dictionary*.—*Loudon's Encyclopædia of Agriculture*.—*Rham's Dictionary of the Farm*.—*Stephen's Book of the Farm*.—*Low's Elements of Agriculture*.—*Young's Farmer's Kalendar*.—*Sir John Sinclair's Code of Agriculture*.—*Sir John Sinclair's General Report of Scotland*.—*Dickson's Husbandry of the Ancients*.—*Lawson's Agriculturist's Manual*.—*Loudon's Hortus Britannicus*.—*Withering's Botany*.—*Catalogue of the Highland Society's Museum*.—*Annales de Chimie et de Physique*.—*Liebig's Chemistry of Agriculture*.—*Turner's Elements of Chemistry*.—*Brown on Rural Affairs*.

BARLEY (POT AND PEARL). The grains of barley, in a prepared state for use as human food. Pot barley was formerly called decorticated barley, and is simply the grain deprived of its husk or skin; and pearl barley is the fine round portion of the grain which remains after the outer portion is ground off. The two kinds differ only in the degree of reduction by grinding; and both are prepared in the barley-mill. See the article **BARLEY-MILL**.

BARLEY-CHOPPERS. Small hummeling instruments, wielded by the hand. See **HUMMELER**.

BARLEY-GRASSES. See **BARLEY**.

BARLEY-HUMMELER. See **HUMMELER**.

BARLEY-MILL. A machine for taking the husks from barley. A barley-mill of the most improved construction is represented in *Fig. 1. of Plate VII.* The water wheel A is eighteen feet six inches diameter, and carries fifty buckets, each of which is three feet three inches wide. On the water shaft B, that carries the water wheel, is fixed the spur wheel C, which is eighteen feet diameter, reckoning from the pitch stroke, and has 340 teeth. The spur wheel C impels the pinion D, of thirty-two teeth, and one foot 8.4 inches diameter, fixed upon one extremity of the shaft E, while the other extremity carries the wheel F, of 150 cogs and seven feet 11.45 inches diameter, to the pitch stroke. The wheel F drives the pinion G, fixed on the stone spindle H, and having a diameter of four feet six inches. The spindle H carries the millstone I, which is four feet six inches in diameter, and one foot five inches thick, and which performs 280 revolutions in a minute. The wheel K, of fifty teeth and two feet diameter, impels the wheel L of the same number of teeth and diameter, which is fixed upon the spindle R. On the spindle R is a conical place, upon which the pinion M, of twenty-five teeth and one foot diameter, is fixed by means of a brass bush fitted into the centre of the pinion, and then bored exactly to fit the cone in the spindle R. Below the base of the cone is a brass ring 3, to keep the pinion M firm upon the cone, by means of four screw-bolts, which bring the pinion firmer to the base of the cone. On the other side of the pinion are two projections 1, 1, commonly called snugs, which take

into similar projections on the end of the catch 2, 5. This catch slides along the spindle R, by moving the lever N, but goes round with the spindle by means of two tongues fixed on the opposite sides of the spindle, one of which is partly visible at 4 in the figure. Two grooves are cut on the inside of the catch, to admit the tongues, in order to carry the catch round with the spindle. The wheel NO, having 102 teeth, and a diameter of four feet 1.4 inch to the pitch stroke, is screwed to the sides of the hoops or cases that enclose the stone. These hoops, a section of which is represented by *a, b, c, d*, are made in two parts, and screwed together by four bolts, 6, 6, 6, 6. They are lined with milled iron, pierced into small holes, in order to permit the escape of the dust, and prevent the barley from being carried along by means of the millstone. When the hoops are turned round by the wheels already described, they are supported and kept clear of the stone by the collars *k* and *i*. The collar *k* is larger than *i*, in order to give room to the spout PT to fill the hoops with barley. This is effected by a thin plate of iron *k*, about an inch larger in diameter than the inside of the collar, which is kept close to the side of the collar next the stone by the staple *l* on each side of the stone spindle. The other end of it is kept fast by the cover of the pillow block *m*. In the plate *k*, a hole is cut for the end of the spout PT. When the barley is made, the hoops are stopped by putting the lever N towards *f*: a small sluice which is upon the side of the hoops, as at *a, b*, is then opened, and the made barley is allowed to run off into the trough Q. When the hoops are thus emptied, the sluice is shut, and the lever N is brought to *g*. By this means the wheel M engages with the spindle R, by the catch 2, 5, and the sluice X being opened, the hoops are filled with fresh barley.

BARLEY-RIDDLE. See **RIDDLE**.

BARM. See **YEAST**.

BARN. A building devoted to the storing and thrashing of the cereal grasses. In every country where corn cannot be thrashed on the harvest-field, and immediately transferred to the granary, it must be stored under protection from the weather, and afterwards thrashed within a roofed building. The barns of Great Britain were formerly of so large capacity as to contain all the produce of farms, whether grain or fodder; and even so late as about 30 or 40 years ago, such enormous barns were regarded by many farmers as essential to their prosperity. Dr. Hunter, who published six volumes of *Georgical Essays* in 1804, occupies an entire essay with the refutation of the reasons which were usually urged by these farmers,—that corn can be built at less expense in the house than in the rick-yard, that it is better protected in the former than in the latter, and that the storing of it in the house is much more convenient for thrashing. But modern improvements in rick-building, in thrashing, and in the





arrangement of farmeries, have convinced the most hesitating, that the rick-yard is both the cheaper and the better place for the great bulk of the produce, and that the barn is needed only for the operations of thrashing, and for the storing of as much corn as will keep these operations in steady progress. A barn which contains a thrashing-floor, thrashing implements, and as much sheaf-corn as would make a rick, is now found to be sufficiently capacious for a middle-sized English farm. But two requisite appendages on every farm of considerable extent are houses or apartments for winnowing the corn and storing the thrashed straw; and these are usually called the corn-barn and the straw-barn.

Small barns in which all thrashing is effected by hand, have all their floor on one level, the thrashing-floor near the middle, and two large doors opposite each other, and on a line with the thrashing-floor; and they require, even more urgently than other barns, to have their floor perfectly dry, and quite inaccessible to damp. But barns in which most of the thrashing is effected by machinery are now so universal on farms of any considerable size, that they alone require any special notice. Very many, perhaps most, of these barns have been built in some one or other of four forms, each adapted to the situation and arrangement of the other offices of the farmery. In one of the forms, the barn and its appendages stand on a straight line, and form one side of a court, the corn-barn and the straw-barn at the sides, the barn itself in the middle, and the horse-course, the wind-tower, or the water-wheel on the back of the barn or exterior to the court. In another form, the barn stands at one corner of the court, the two appendages form wings to it, but stand on different sides of the court, or at right angles to each other, and the horse-course is situated behind the part which adjoins the straw-barn. In a third form, the barn abuts backward from the centre of the north side of the court, in shape like the letter T, having the straw-barn in a line with the court, and the corn-barn projecting from its middle into the stack-yard, with the mill at the end next the straw-barn, and the horse-course in one of the angles. In the fourth form, the barn is the upper part of a two-story building, and the corn-barn and straw-barn occupy the ground floor.

But whether built in any of these forms or in some other, a barn is capable of being greatly modified in size to suit the extent of the farm, in internal construction to suit the particular method of farm management, and in exterior adaptation to suit both the peculiarities of the site and the general arrangement of the farmery. When foreign wood and slate roof are employed in the erection, the barn is usually much wider, than when home-grown timber and roofs of heath or thatch are used. Some barns, even in excellent farming districts, have a width of only 18 feet within the walls; but no really good barn

has a width of less than 20 feet. A barn of 35 feet in length and 20 feet in width, exclusive of the space occupied by the machinery, can contain as much as two moderately sized ricks, or from 50 to 60 bolls; yet a barn for a very large farm—in order, both to afford ample storage for unthrashed corn in unfavourable weather, and to allow space for a straw-cutter, clover-thrasher, and other subordinate matters—ought to have an extent of 60 feet in length, and from 20 to 24 feet in width. The straw-barn should be situated in immediate adjunction to the thrashing-machine; it must contain storage for at least fodder-straw and litter-straw; and it ought, if possible, to afford both space and easy outlet for straw of the different grains, or of four principal qualities. The corn-barn must be proportionate in size, and must have attached to it a chaff-house, and a communication by stair or gangway with the granaries. See the articles THRASHING, WINNOWER, GRANARY, and FARM-BUILDINGS.

A barn situated on the face of a rapid slope, and built two-story high, might have its own floor on a level with the rick-yard, and the floor of its corn-barn and its straw-barn on a level with the court; an arrangement which would happily facilitate both the ingress of the unthrashed corn from the ricks, and the egress of the thrashed straw to the cattle-houses. A barn whose floor is on a level with the whole of the surrounding ground, may be provided with wide and lofty gates through its sides, to permit a loaded cart to enter, unload, and pass on; but, in this case—if provided, as it ought to be, with a thrashing-floor for samples of grain and for the whole bulk of such small seeds as those of clover—it will sustain serious damage from both the tread of the horse and the abrasure of the wheels. A ground-floor barn, without gates, may be provided with an opening or pitch-hole, through which the unthrashed corn can be forked from a loaded cart on the outside; but this device occasions the unloading to be extremely tedious, and is either useless or mischievous in showery weather. A barn on an upper story may communicate with the rick-yard by a gangway, and receive its supplies of unthrashed corn by hand-carriage or by the wheel-barrow; or the building in which it is situated may be provided across one end with a covered space or sort of rude piazza, wide and lofty enough to admit a loaded cart, and having a side opening or pitch-hole to allow the corn to be forked into the barn. A common roofed two-story barn may be so extended by lateral erections, as to overshadow and shelter with its roof a series of cattle-sheds; and its straw-barn on the ground-floor might be provided with slits or openings for affording to these sheds immediate supplies of fodder and litter.

The walls of a barn are variously built of earthen composition, timber, brick, and stones. Earthen composition ought never to be used when better materials can be economically ob-

tained ; and, when unavoidably employed, it ought to consist either of a similar preparation to what is suitable for thrashing-floors, or of well-tempered and unabsorbent mineral matter, mixed or alternated with chopped straw. Earth and timber are sometimes jointly used, by a frame-work of boards being erected two feet in width, a hard packing of perfectly dry earth being consolidated into all the frame-work, and a coat of plaster of Paris, or of very fine mortar, being laid over all the exterior. When stone or brick is employed, all the interior should receive a coat of plaster, and the ceiling should be lathed and plastered ; and when the stone is built in rubble masonry, a coat of rough-cast plaster ought to be given to the exterior. The stone or brick walls of properly constructed barns, after the roof is put on, are built at the top, by some careful farmers, close up to the covering, and well plastered between the scantlings.

The roof ought, for the sake of economy, to be so constructed, as to acquire all requisite strength from the least possible expenditure of timber. The imposing of the whole weight upon strong horizontal beams, without producing aid from trussing, displays a meagre, uninventive, hobnail state of mind, scarcely worthy of a Caffre or a Hottentot. When tiles are used for covering the roof, they ought to be laid in mortar, or, what is much better, in coarse, compact hay. Straw thatch, though a very common covering, affords a ready and almost impregnable retreat for rats. Any reeds which contain a considerable quantity of silica, or which have a hard and brittle texture, make an excellent covering, both for resisting vermin and affording full shelter from the weather.

The floor of the barn, if it be a one-story building, or of the corn-barn, if it be situated below the thrashing-barn, requires to be carefully constructed in some manner which will afford perfect protection from both damp and vermin. If the floor be laid with deal, and not built solid with stone and mortar, the spaces between the scantlings may be filled with very clean, dry gravel, well beat down ; or if gravel cannot be obtained, or should not be deemed necessary, openings ought to be left under the floor to admit cats to every point where vermin might lodge. In clay floors, to prevent the burrowing of vermin, a considerable quantity of broken glass is sometimes mixed with the materials of the floor, for the space of three feet all round the walls. Mr. Stephens mentions, in his "Book of the Farm," a very effectual method of construction which he adopted for preventing the attacks of either damp or vermin. "The earth, in the first instance," says he, "is dug out of the barn to the depth of the foundations of the walls, which should be two feet below the door-soles ; and in the case of a new steading, this can be done when the foundations of the walls are taken out. The ground is then spread over with a layer of sand, sufficient

to preserve steadiness in the stout rough flags, which are laid upon it, and jointed in strong mortar. Twelve-inch thick sleeper walls of stone and lime are then built on the flags to serve the purpose of supporting each end of the joists of the floor. The joists, formed of 10 by 2½ inch plank, are then laid down 16 inches apart, and the spaces between them filled up to the top with stone and lime. The building between the joists requires to be done in a peculiar way. It should be done with squared rubble stones, and on no account should the mortar come in contact with the joists, as there is nothing destroys timber, by superinducing the dry rot, more readily than the action of mortar upon it. For this reason, great care should be observed in building in the joists into the walls, in placing the safe-lintels over the doors and windows, the stones being dry-bedded over them, and in beam-filling between the couple-legs. The floor is then properly laid on a level with the door-sole, and finished with a neat skirting board round the walls of the barn. By this contrivance, the vermin cannot possibly reach the floor but from the flags, which are nearly two feet under it. This construction of floor admits of abundance of air above and below to preserve it, and affords plenty of room under it for cats and dogs to hunt after the vermin."

A thrashing-floor is, of course, a principal feature of all barns when no thrashing-machine is used ; but it is highly desirable and even requisite in other cases, for the thrashing out of small seeds, such as those of clovers and grasses, for which the thrashing-machine is not properly adapted. The thrashing-floor of a one-story barn is generally situated across the centre ; and when the width of the barn is not sufficient for it, porches are added to the doors, to admit of its elongation. The divisions of the barn which are separated by the floor, or situated between it and the ends, are called the bays, and the storings of unthrashed corn in them are called the mows. But, when a barn is so constructed as to receive its supplies or unloadings of unthrashed corn at one end, the thrashing-floor is situated across the other end, and the corn is stored in the intermediate space. In a barn upon the second story of a building, the thrashing-floor must be firmly supported and kept quite steady by pillars or a partition wall below, and must be so strong and well-jointed as not to permit a filtration of fine dust. An ordinary thrashing-floor measures from 18 to 20 feet in length, and from 12 to 14 in width ; yet every one must be modified in extent to suit the number of flails which it is expected to keep in play. A brick thrashing-floor is liable to bruise the corn, to imbibe moisture, to give off pulverizations of its substance into mixture with the corn, and to hurt the hands and damage the implements of the workers. A stone-thrashing-floor may or may not be eligible according to the nature and texture of the stone employed, and to the degree of skill employed in

the dressing and laying of the stone; but, in most instances, it is nearly or quite as objectionable as a brick thrashing-floor. Some earthen or mineral composition thrashing-floors are tolerably good, others are of medium character, and others are altogether bad, according to the nature of their materials and the method of their construction; yet by far the greater number are subject to the very serious objection of slowly pulverizing and passing into commixture with the corn. The following method of forming an earthen floor is noticed by the Rev. Mr. Rham as an usual one:—"The soil is taken out to the depth of six or eight inches or more, and, if the subsoil is of a moist nature, a layer of gravel and dry sand is laid on the bottom 3 or 4 inches thick, and trod smooth and level. A mixture is made of clay or loam and sand, with water, to the consistency of common building mortar, to which is added some chalk or pounded shells or gypsum, where these can be obtained; chaff, cow-dung, and some bullock's blood are added; and the whole is well worked up together. Of this a coat is laid on the prepared bottom with a trowel, about an inch thick, and spread evenly. This is allowed to dry; another coat is then put over, and all the cracks carefully filled up. This is repeated till the desired thickness is produced. When it begins to harden, the whole is well rammed with a heavy wooden rammer, and every crack filled up so as to give it the appearance of a uniform solid body. This is left to harden slowly, neither exposed to the rays of the sun nor to draughts of air, and in a short time the floor becomes sufficiently hard to be used. It is advisable, however, to give it some months to consolidate entirely. The best time for laying such a floor is in spring, that it may be completely hardened before the succeeding winter." A kind of thrashing-floor not dissimilar to this was common among the Romans. Columella states that they first dug up the ground to some depth, in order to moisten it with fresh lees of oil,—that they then mixed it with chaff, and rammed it down as closely as possible,—that, after it became dry, they stopped up all cracks and crevices which appeared,—that they continued, with great force, to beat it down, and render it quite level,—and that, finally, they strewed it with chaff, trod the chaff into it, and left the surface to be completely dried by the sun. Columella, Cato, and Varro, all assert that the preparing of the thrashing-floor with the lees of oil prevented the appearance of mischievous vegetation, and contributed to preserve the corn from the attacks of mice and ants. A thrashing-floor of oak or of other lasting timber, though more expensive than any other kind of thrashing-floor in its original construction, is eventually the cheapest and in all respects the most eligible; and, in particular, it gives far the best play and rebound to the flail, and yields neither discolouration nor powdery matter to the grain. The

oaken planks ought to be $2\frac{1}{2}$ inches thick, well joined at the edges by dowelling, or by ploughing and tonguing, and made firm upon oaken sleepers by means of a few iron spikes. Beech planks may be used, 2 inches thick, well dowelled together, and laid upon a bed of small boulder stones; and they are considerably more economical than oaken planks, and will wear very smooth, and not splinter. Planks of elm may also be very successfully employed.

The preservation of corn from a close and musty smell, and from other indications of chemical change and decay, exceedingly depends, not only upon perfect protection from moisture, but upon a free and abundant circulation of air. Every barn, therefore, ought to be pierced with a sufficient number of slits or openings to admit of such a circulation; and the corn ought to be so laced and so lightly built as to allow the air to percolate everywhere to its centre. An excellent contrivance for combining perfect circulation of air, with facility of shelter during a rainy harvest, and with one or two other important conveniences, is a structure called a skeleton barn. This is a barn, not in any degree for thrashing, but wholly for storage; and sustains a middle character between a large corn-rick and the bays of a thrashing-barn. On a timber platform, laid upon capped stones, is erected a rough timber frame of a perfect two-story barn; the roof is covered with thatch or tiles; and a downward extension of the roof is so far continued on both sides as to overhang open wings or piazzas of sufficient width and height to admit a corn-laden cart or waggon. The whole of the interior of the barn frame is used for the storing of unthrashed corn, and serves exactly the purposes of a huge rick, with the double advantage of saving all the cost and trouble of annual thatching, and of affording entire protection at every height, or to a store of corn a few feet high as fully as to a store which reaches to the roof; and the wings serve as a shelter, under which carts or waggons can be drawn and unloaded, and afterwards may either be used as cart-sheds, or provided with platforms, and used, like the centre, for the storage of unthrashed corn. The convenience of such an erection is, in almost any circumstances, considerable, and, during a critical rainy harvest, is exceedingly great; nor, in most cases, will it, upon an average of years, cost much more, or perhaps any more than ordinary annual rick-building. Another kind of skeleton barn—oftener used, however, for hay than for corn—consists simply of the wooden frame of a common one-story barn, without wings or gates, the bays being used for storage, and the central place of the gates and the thrashing-floor being left open and unoccupied for the unloading or the temporary shelter of a cart of hay.

Skeleton hay barns are very common in some districts of England, and, where they exist, are generally much appreciated. The skeleton of a

common one-story barn serves well for the accommodation of farms in which hay is tied up in trusses for the supply of the market; and barns of a larger size and firmer construction, with a foundation of masonry, a slight open frame-work, and a fixed roof, are highly serviceable as store-houses of hay for home consumption on the farm. Suppose one of the latter sort to cost fifty pounds, and to have capacity for fifty loads of hay, the annual cost of its storage may be computed at from eighteenpence to two shillings per load; and the barn, for this trifling cost, affords a safe receptacle for hay as soon as it is dry, saves the expense and trouble of stacking, gives protection from the effects of a heavy shower in the act of unloading, and affords complete shelter to all broken cuts of the hay during winter. A curious skeleton hay barn, or sort of permanent rick-frame, with a vertically moveable roof, is extensively used in Holland. It consists of strong upright poles, and a roof which is supported by them, and can be lowered or raised; and it is usually pentagonal, or comprises five poles, situated at the angles of a regularly pentagonal area. The poles are kept erect and firm by means of a strong sill on a brick foundation, and of diagonal bars acting as spurs; and the roof is light, pentagonal, and thatched, and is provided at the angles with strong wooden blocks, which have perforations for the admission of the poles. Each pole is pierced with a series of holes; iron pins are inserted in these holes, as supports to the blocks of the roof; and by removing the pins to lower or higher holes, the roof is lowered or raised. The work of raising the roof is progressive, or from angle to angle of the pentagon, and from hole to hole of each pole; and it is effected, in each act of the process, by means of a small jack, similar to what is used in lifting waggons or heavy-laden carts to let their wheels be removed. A similar skeleton hay barn exists in some parts of France, and has its roof lowered or elevated by means of a screw in the centre. The purpose served by the mobility of the roof is to have the hay always closely covered; and it is raised piecemeal when the hay is stored in small quantities and on different days, and lowered from time to time as the uppermost parts of the store are removed for forage. — *Sir John Sinclair's General Report of Scotland.* — *Marshall's Rural Economy of the Southern Counties.* — *Marshall's Rural Economy of the Midland Counties.* — *Survey of Essex.* — *Hunter's Georgical Essays.* — *Knowledge Society's British Husbandry.* — *Doyle's Practical Husbandry.* — *Rham's Dictionary of the Farm.* — *Stephens' Book of the Farm.* — *Quarterly Journal of Agriculture.* — *Dickson's Husbandry of the Ancients.* — *The Society of Gentlemen's Complete Farmer.*

BARN MANAGEMENT. Neat, economical, orderly management of barn work, and the consequent presenting of clean corn at the market,

are strong indications of good farming. Barn work is performed principally during winter, and affords a pleasing alternation to the labours of the field. The extent and intricacy of it are, in some degree, proportioned to the size of the farm; yet a notice of its details on a rather large scale will sufficiently indicate its duties on farms of any size. The hand implements used in it are few and simple. The flail, where the thrashing-machine does not exist, is as primitive and homely an instrument as could well be conceived for accomplishing a great and most valuable result. See **FLAIL**. The corn barrow, used for wheeling sheaves from the rick-yard up the gangway to the upper barn, is a long-shaped wheel-barrow, made light and open with spars. Riddles, employed in sifting, have their mesh-work either of wires or of stripes of ash; and are of various meshes, to suit the different kinds of grain, and the different objects of sifting; but all are of simple construction, and easy price. Wechts for lifting thrashed corn, ought each to contain at least half a bushel; and, when made of broad slips of ash, are light and handy. The bushel, used for measuring the thrashed corn and filling it into sacks, cannot be too lightly constructed, provided it is hooped with iron on all the parts which are most subject to abrasion; and it best serves the purposes of both convenience and stability, when it is nearly as wide at the top as at the bottom, and has a couple of handles about one-third way from the top. A strike, for making an exact level of grain across the surface of the bushel, suits better to be flat than cylindrical; for a zigzag motion arranges the grain into a truer level than a direct motion. Shovels made each of one piece of plane-tree, with a broad mouth, a little turned up on each side, and handled like a common spade, are the best adapted to both the corn-barn and the granary. A hand hummeler for barley is indispensable wherever a hummeling apparatus is not connected with the thrashing-machine, and, of course, whenever thrashing is done with the flail. A light broad hand-hoe, made of wood, with a very short handle, is an useful implement for drawing the thrashed grains into the wechts. See the articles **WECHT**, **BUSHEL**, **RIDDLE**, **SHOVEL**, **BARROW**, and **HUMMELER**.

The flail, though one of the simplest and most ancient of implements, is still used for thrashing in most parts of Ireland, in many parts of England, and on most Scottish farms which cannot, in the routine of their horse husbandry, employ two pairs of horses. To erect a thrashing-mill on any farm which has not regular work for two pairs of horses, would be decidedly uneconomical; so that the line of demarcation between the profitable use of the flail and the propriety of superseding it by machinery is very distinct and broad. The saving from the use of a thrashing-machine on even a very large farm is greatly less than superficial observers and even many

farmers suppose. The costs of flail-thrashing and of machine-thrashing, indeed, cannot, with perfect accuracy, be very directly compared; for the flail-thrashing of long-strawed corn is accomplished in the same length of time as the flail-thrashing of short-strawed corn, while the machine-thrashing of corn is nearly proportionate in speed to the shortness of the straw; so that if the cost of thrashing one crop with the machine should be one-fourth less than with the flail, the cost of thrashing another crop with it might be one-fourth more. Yet, on the assumption that the crop is of medium character, the following calculation may be adopted:—"The quantity of corn which a man and six women could take into the barn and thrash, in a short winter day, would not exceed 22 quarters. That quantity may be considered good work for that number of people, with an ordinary six-horse power thrashing-mill, propelled by an abundant supply of water. The wages of six women at 8d. per day, and the man, being a trusty one, at 2s., would give 6s. for taking in and thrashing 22 quarters of grain, or 3½d. per quarter. It would take four women and the same man a day in winter to clean completely and measure 22 quarters of grain, that is 4s. 8d., or 2½d. per quarter. Both would give 5½d. per quarter. The machinery of the mill, with its ark, dam-sluices, and fore and back leads, for bringing to and taking away the water from the mill, could not be executed for less than £200 of outlay of capital, which, at 7 per cent. per annum for tear and wear of machinery, and interest of capital sunk, would be £14 a-year; and if the farm yielded only 370 quarters of grain, that would be 9d. per quarter expense, which, added to the 5½d., would give a total of 14½d. per quarter of expense in thrashing a crop by means of a water-power thrashing-mill. Now the ordinary amount of thrashing corn by the flail is 13½d. per quarter; and allowing the barn-man four women one day to clean the 22 quarters of grain, his own wages being included in the allowance, their wages will be 2s. 8d., or 1½d. per quarter. Both will be 14½d. per quarter. No expense of taking in the crop to the barn, in the case of thrashing with the flail, would be incurred, because, when such a mode is adopted, the thrashing-barn is placed conveniently to the stacks for the purpose. Hence, on the score of mere pecuniary saving, unless a farm were to produce more than 370 quarters of grain, it would scarcely be worth while to lay out capital for the erection of a six-horse power thrashing-machine, propelled by water-power."—[*Quarterly Journal of Agriculture*.] Yet the thrashing-machine, quite irrespective of its immediate work, wields a great and valuable controlling power over the economy of the farm; it affords an ample supply of forage and litter, at the farmer's will, for the live stock; it permits a superior command of labour for the field, in adaptation to the exigencies of weather;

and, especially, it commands the time and the market for the safety and the sale of grain. These advantages are worth far more than the mere costs of thrashing; and they rise in magnitude and value proportionably to the amount of the cereal produce of a farm.

When the supply of unthrashed corn in the barn is exhausted, the contents of a rick must be taken in from the rick-yard. If these are removed with a cart, the ricks have been built so far apart from one another as to permit with ease the passing among them of a loaded cart; and the sheaves are forked from the rick to the cart, and again from the cart into the barn. But when they are otherwise removed, a more complex process is necessary. A large sheet of coarse linen cloth or of thin canvass is spread on the ground at the foot of the rick, to receive the sheaves as they are thrown down; part of the thatch of the rick, if not too wet, is spread beneath to soften the fall of the sheaves; and a few of the sheaves are laid along the exterior sides of the sheet, to prevent it from being ruffled by the wind or trodden by the workers. The man who has charge of the barn-work, lifts the sheaves with a light fork in an opposite course to that in which they were built, and pitches them upon the sheet; one of the barn-women loads the sheaves upon corn-barrows; two or three women, each using a barrow, according to the extent of the work, and the distance to the barn, wheel the laden barrows up the gangway into the barn; and two pack the sheaves into convenient order for thrashing, and put aside for the earliest thrashing all sheaves which have become loose in the handling. In some instances, the old method of carrying the sheaves on the back is still practised; and in others, hand-barrows of canvass are used instead of corn wheel-barrows. When the thrashing-machine is driven by horse-power, the carriage of corn from the rick to the barn is advantageously effected by horse and cart, and may go on simultaneously with the thrashing; for as three pairs of horses are required for the mill, field horse-labour, on every moderately-sized farm, must be in abeyance whenever the mill is at work. Under this arrangement, only four women are required; but, when the mill is driven by water, wind, or steam power, six women, with the superintending man, are needed; and though they cannot simultaneously carry and thrash, yet they can do both, for one rick, in the shortest winter day. After the whole rick has been lifted, the shed corn upon the sheet is carefully collected, and all grain-straws upon and around the site of the rick are raked together and saved. Should any of the sheaves at either the top or the bottom of the rick be damaged, they are placed aside and thrashed separately from the rest of the corn; for if, through carelessness or inadvertence, they are not thus treated, they will seriously deteriorate the sample and price of the produce at the market.

Of the seven persons who conduct the work within the barn of an ordinary-sized water-power thrashing-mill, the man feeds the corn into the mill, two women supply him with loosened sheaves, two women riddle the corn and attend to the chaff in the corn-barn, and the remaining two women fork up and build the straw in the straw-barn. All these workers are required for the performing of good work with a powerful mill; and an eighth person is needed to drive the horse in a horse-power machine. So few as three persons are employed in many a barn,—the man to feed the machine, a woman to supply him with sheaves, and a woman to do the work of the corn-barn; but though these may go through the task in a slovenly manner, they cannot possibly give due attention to the working of a well-driven six-horse power thrashing-machine.

The feeding and managing of the thrashing-machine are the most onerous part of the work, but cannot be properly understood without a knowledge of the machine's structure and mode of operation, and will be noticed in the article THRASHING. The work of the corn-barn is simultaneous with that of the upper barn. One hopper in the winnowing-machine sends down to the floor of the barn the good grain, with an admixture of the heavier kinds of foreign substances; and another hopper sends down the light corn, the heavier parts of the chaff, ears of corn which have been broken off and partly thrashed, and the larger parts of weeds. The good grain is hand-riddled into a heap at a convenient part of the barn; it is afterwards kept free from all chaff, straws, and larger refuse; and the tails or lower portions of the heap are re-riddled before being shovelled up to the top. The refuse of the riddlings is added to the matters sent down by the second hopper; and all these together are called roughs or shag, and are variously treated according to the nature and condition of the grain. The roughs of barley are all reserved for the peculiar process of hummeling; and the roughs of oats and wheat are subjected to thorough hand-riddling in the same manner as the disgorgements of the first hopper. The refuse of the ordinary roughs of oats may be thrown into a heap, to be used as fodder; and the refuse of the roughs of wheat or of badly thrashed oats are collected upon a chaff-sheet, and carried up to be re-thrashed. But in some thrashing-mills, an apparatus of buckets revolves with the machinery, and carries up all the roughs from the spout of the second hopper to be re-thrashed; and, in such cases, only one riddler, instead of two, is required in the corn-barn.

The chaff, during the process of thrashing, is thrown into an apartment by itself; and this ought to be thoroughly partitioned from the corn-barn, to prevent the communication from it of clouds of dust. The riddlers of the grain

look, from time to time, through a convenient opening into the chaff-apartment, to observe when the chaff makes a great accumulation at the end of the winnowing-machine, and to remove it thence into the interior.—The straw, as it passes from the machinery into the straw-barn, is forked by the workers into a mass, and built up and tramped in the manner of stacking hay. In some instances, the straw slides down a rack from the shaker of the mill; and any corn or chaff which it may have swept along with it falls through the rack. The corn is more readily separated when the straw passes under, than when it passes over, the shaker of the mill.

A process of winnowing and cleaning follows the thrashing and winnowing process; it is, in most cases, all performed by hand in the corn-barn; and, in these cases, to correspond with the scale of labour which we have described, it requires four women and a man. But, in some instances, a second winnowing-machine is placed below the first, in connexion with the thrashing-mill, and is made to serve all the purposes of thorough or final winnowing; and, in others, a second is placed on the same level as the first, but also in connexion with the thrashing-mill, and receives the grain after it has been riddled by the hand on a roller of canvass. The latter of these contrivances is the better of the two, as it permits the riddling to occur between the two winnowings, and in general brings the grain into such a clean condition as to be fit for immediate storing in the sacks. Yet even when either of the contrivances works with the utmost possible efficiency, a hand winnowing-machine is frequently desirable, or all but indispensable, for performing occasional pieces of work, of much importance to the farmer, but too small in amount to repay the cost and trouble of setting on the mill-power. Hence, by far the most general practice is to effect the second winnowing in the corn-barn, by means of a hand winnowing-machine.

When no chain of buckets is attached to the thrashing-mill to carry away the riddled roughs, these are passed through the hand-winnowing machine; and, in order that the chaff which they contain may not pollute the barn, but may be blown away, the end of the machine is placed so as to project out of the barn-door. The roughs are fed by the hand through the hopper; and the grain, if passably clean, is riddled upon the heap of good grain,—but if not pretty clean, is riddled into a heap by itself, to be subjected to another winnowing. The barn-man drives the machine; one of the women feeds the grain through the hopper with a wecht; another takes away the corn, wechtful by wechtful, from the machine; and the two others stand at a little distance, receive each into a riddle one-half of every wechtful of the corn, and riddle it together upon a heap. The machine is regulated according to the condition and quality of the grain; the hind-

board is placed so high as to prevent any of the grain from being blown over with the chaff; and the inner side is so placed as to allow all the light grain to escape over it. The fans should generate a good blast of wind; the motion should be as steady as the application of human force can possibly make it; the supply of grain to the hopper should be regular; and, as regularity of motion greatly depends upon the pressure of a good weight upon the shoe, the hopper should be always kept full. See the articles **WINNOWER** and **WINNOWER-MACHINE**.

The riddling is the most important of the manual operations. It separates, or ought to separate, from the corn all the heavy heads of weeds, short pieces of straw, small stones, little bits of hard earth, and grain enclosed in their capsules, which the wind of the machine is not strong enough to blow away. Yet the dexterous or proper practice of it is almost as difficult as it is important; it cannot be learned, or even understood, from any mere printed description of it; and, though appearing to the eye, to be very simple and easy, requires much practice and a considerable degree of cleverness and adroitness. If it do not separate all, or very nearly all, foreign matter from the grain, it fails to serve its particular purpose, and is badly performed. The end of each riddling of the riddler of grain is brought towards the side of the heap, that it may be riddled over again before it is shovelled up to the top of the heap. Yet one course of winnowing and riddling is seldom sufficient to effect a thorough cleaning. A slow transit through the hopper, followed by very expert riddling, is sometimes quite successful; but, in general, a second passage through the machine is requisite for oats, and both this and a second riddling are requisite for barley and wheat. When a second winnowing, but not a second riddling, is practised, one of the women drives the machine, another supplies the hopper, another carries away the grain from the machine to the bushel, the fourth assists to hold the sack for the reception of the grain from the bushel, and the man fills the grain into the sack, and wheels the latter away with the corn-barrow. When a second riddling is practised, the process is the same as at the first, with the exception that the grain may be allowed to pass more rapidly through the machine. The light grain which has escaped over the inner slide of the machine is now winnowed and riddled till it parts with all the good grain which is mixed with it; and the refuse of the riddling, or the finally light grain, is re-riddled from remaining commixtures of sand, weed-seeds, husks, and other impurities. Purified final light grain of oats and barley can be set apart for the use of poultry; and that of wheat, if not malted by wet weather, will make good household bread.

Though we have represented cleaned oats as measured, wechtful by wechtful, into the bushel during the progress of the second winnowing, yet

most farmers are probably aware, that the measuring of grain from a heap, while the barn-floor is in a state of perfect rest, brings out a somewhat larger result. "It is found by experience," says a writer in the *Quarterly Journal of Agriculture*—whose casuistry or moral reasoning on this subject, however, has not altogether our concurrence—"It is found by experience, that when a bushel is filled at once, it can be filled with a less quantity of grain than when it is filled by degrees with small quantities. On the same account, a bushel, when filled, should not be heaped up with grain high above its rim, nor should the grain be forcibly poured into it, nor should a commotion be allowed on the barn-floor, particularly if it is a wooden one, when grain is being measured. Hence one reason for the expediency of the plan to measure from the heap instead of the machine, from which the bushel would be filled only by small quantities, and each quantity shaken down by the tremulous motion imparted to the floor by the machine. There is no trick or unfairness in a farmer taking these advantages in filling his measure when they are in his power, and when he thinks it worth while to pay attention to them. He is obliged to fill the measure by ordinary means, but he is not obliged to use means to press or tramp the grain into it, into the least bulk it can assume. On a large quantity of corn, and for a series of years, the difference produced between a proper and impressed measure of it might be very considerable. We are not aware that this difference has ever been accurately ascertained by experiment, any more than the leakage of grain in a granary, or, what is still more difficult to be ascertained than either, the shrinkage of grain in the stack after it has stood in the stack-yard a second year. The difference in the measurement of grain, like the shrinkage of it in the stack, must depend, we presume, very much on the quality of the grain, and the state in which it had been harvested. Good, plump, dry grain must both measure out its quantity more certainly, and shrink less, than ill-filled hungry stuff." The fact seems to be that prime grain in prime condition will measure quite or very nearly the same under any mode of filling the bushel; and that light, chaffy, moist, ill-conditioned grain is capable of the enlarging effects of a soft method of measuring, very nearly in the proportion of its worthlessness. Hence our demur at the alleged justice of a bushel being filled with all possible absence of shaking or compression.—We might now, without overstretching the subject of barn management, proceed to speak of the making up and removal of grain to the purchaser; but we defer this topic to the article on **MARKETS**.

BARNACLES. Instruments used by farriers to put upon the muzzle of horses, when they will not stand quietly to be shod, bled, or dressed. The object of these instruments, and of another called the twitch, is to produce as much pain in

the muzzle as will draw away attention from the pain caused by the shoeing or the surgical operation. The common barnacles are rollers of wood, bound together, and made to enclose and compress the muzzle; another kind have handles, and operate like pincers; and a third sort are held together at the top by a ring enclosing buttons. Much unnecessary pain is often, from inconsideration or cruelty, inflicted with these instruments; yet, in some instances, even the highest degree of it fails to accomplish the veterinary surgeon's purpose, so that he is obliged to have recourse to the strong means of restraint afforded by the side-line or the hobbles.

BAROMETER. An instrument for determining the weight of the air, and the variations of its pressure in different circumstances. As every change in the weight of that fluid is accompanied with corresponding changes of density, and consequently of its disposition to absorb or deposit moisture, the barometer is also employed to point out the probable changes of weather; hence it is not unfrequently called a *weather-glass*. Another purpose, scarcely less important, to which this instrument has lately been much applied, is the measurement of accessible heights; and the results obtained by means of it approach so near to perfect accuracy, when all circumstances are properly estimated, that this method of determining the heights of mountains is, in many cases, even preferable to the geometrical methods. It also appears from the observations of Captain Flinders, that the barometer may be of the most essential service at sea, not only to foretell changes of weather, but also to indicate the vicinity of land. These important properties entitle this instrument to a considerable share of our attention.

Before the discovery of the weight of the air, the barometer was entirely unknown; and, indeed, it was the discovery of that fact, which led to the invention of the instrument. Evangelista Torricelli, a pupil of Galileo, and his successor as mathematical teacher at Florence, was the inventor of the barometer, about the middle of the 17th century. He conjectured that the same cause which raises water 33 or 34 feet high (see *ATMOSPHERE*), a discovery of Galileo, ought to raise mercury, which is nearly 14 times heavier, only 29 or 30 inches high. He therefore closed a tube of glass, several feet long, hermetically at one end, then filled it with mercury through the orifice at the other end, and inverted it in a vessel of mercury. He was not deceived in his expectations: the mercury descended from the upper part of the tube, and remained in a column 29 or 30 inches high. The upper part of the tube, which, in this experiment, became empty, was thence called the *Torricellian vacuum*. Further experiments of Torricelli proved the correctness of his idea that the column of mercury was supported by the pressure of a column of air resting upon the column of mercury in the tube,

and extending to the limits of the atmosphere. Whilst Torricelli was still occupied with this object, death overtook him, in 1647. The above-described preparation, which is the barometer itself, is called, after him, the *Torricellian tube*. Pascal adopted his opinions, and performed many experiments in confirmation of them. He requested one of his relations, Perrier, at Clermont, in Auvergne, to make a trial of the pressure of the air on the mountain Puy-de-Dome. Perrier found that the quicksilver in the Torricellian tube, upon the summit of this mountain, 5,000 feet high, stood more than three Parisian inches lower than at the foot of the mountain; and thus demonstrated that it was not the horror of a vacuum, as had been previously supposed, but the pressure of the column of air (the height and the weight of which were less on the mountain), that supported the column of mercury in the tube. The gradual fall of the mercury, in ascending the mountain, was also observed. It could not escape the notice of the first inventors of the barometer, that the situation of the mercury in the Torricellian tube was almost daily changing. They concluded that the pressure of the atmosphere must be subject to continual changes, and that, on this account, this instrument would be useful for pointing out and measuring these changes.

The experiment of Torricelli was so simple, and yet so easy to be exhibited under a variety of forms, that a great number of barometers were soon proposed, either with a view of rendering them more correct, or enlarging the extent of the barometrical scale. Before we proceed to give particular descriptions of these instruments, and of the various attempts which have been made to increase their accuracy and sensibility, it may not be improper to make some previous remarks applicable to barometers in general.

The tubes intended for barometers ought to be sealed hermetically at both ends, immediately after they are made at the glass-house, and to be kept in that state till they are to be fitted-up. Without this precaution, they are apt to be sullied with dust, moisture, and other impurities, which it is almost impossible afterwards to remove, on account of the smallness of their diameters. When they are opened—which may be done with a file—care should be taken not to breathe into them, or to wash them with spirit of wine, or any other fluid; experience having proved, that in tubes so treated, the mercury always stands a little below its proper level. This is, no doubt, owing to the adhesion of a little of the spirit of wine to the sides of the tube, which being afterwards converted into vapour, renders the vacuum above the mercury imperfect. If any cleaning is necessary, it may be done with a fine linen rag, that has previously been well dried.

The tubes ought to be as perfectly cylindrical as possible, though, in some cases, this is not absolutely necessary. They should be about 33

inches in length, and the diameter of their bore should be at least 2 or $2\frac{1}{2}$ lines, otherwise the friction, and capillary action, will be apt to affect the free motion of the mercury. The glass should not be very thick, as it is apt, in that case, to break, when the mercury is boiled in the tube: half a line is sufficient.

The mercury ought to be perfectly pure, and free from all foreign metals. The best is what has been recently revived from cinnabar; the common mercury of the shops being often adulterated intentionally with tin, lead, and bismuth, stands at various heights in the tube, according to the nature and quantity of the foreign substances with which it is amalgamated. The different mechanical methods which have been proposed for purifying mercury, are, for the most part, ineffectual; we would, therefore, recommend the revivification of the metal from cinnabar, for nice barometers, as being least liable to uncertainty. For this purpose, take a pound of cinnabar, and reduce it to powder; mix it well with five or six ounces of iron, or steel filings; and having put the mixture into an iron retort, expose the whole to the heat of a reverberatory furnace; the mercury will soon pass over in a state of great purity, and may be obtained by adapting to the retort an earthen receiver which has been previously half filled with water. Before being introduced into the tube, the mercury ought to be well heated, or even boiled in a glazed earthen pipkin, in order to drive off any moisture which may adhere to it; but this will be unnecessary, if the mercury has been recently revived.

The mercury ought likewise to be boiled in the tube, to expel any air or moisture which may still remain attached to it, or to the inside of the tube. This is done in the following manner: Pour as much mercury into the tube as will make it stand to the height of three or four inches; and introduce a long wire of iron to stir it during the act of boiling. Expose the mercury in the tube gradually to the heat of a chafing dish of burning charcoal; and when it begins to boil, stir it gently with the iron wire to facilitate the disengagement of the bubbles of the air. When the first portion of the mercury has been sufficiently boiled, and all the air extricated, remove the tube from the chafing dish, and allow the whole to cool, taking care not to bring it into contact with any cold substance. Introduce an equal quantity of mercury, and treat it in the same manner, withdrawing the wire a little, so that it may not reach below the upper part of the mercury already freed from air. The chafing dish must also be placed immediately under the mercury which has been last poured in. Repeat the same process with each successive portion of mercury till the tube is filled, always applying the heat very cautiously; and be equally careful in allowing it to cool, before a fresh portion of mercury is poured in.

It sometimes happens, when the tube is carefully inverted, as in the Torricellian experiment, that the mercury, after being completely freed from air, in the way we have described, remains suspended in the upper part of the tube, and does not assume its proper level, with respect to the pressure of the atmosphere, till the tube has been gently shaken. This fact—which seems to have given great difficulty to Huygens—is certainly owing to the capillary attraction of the tube, and the mutual attraction of the particles of mercury, as it takes place only in tubes of a small bore. To say that it is owing to the influence of an invisible ethereal fluid more subtile than air, is no less unphilosophical than the semicircular hypothesis of Linus, or the principle of the horror of a vacuum, particularly when we can assign a cause for it, of whose operation we have many simple and obvious proofs.

The common barometer, represented in *Fig. 2, Plate VII.*, differs but little from the Torricellian tube. Instead of a bason, a small reservoir is usually attached to the lower extremity of the tube, or rather the tube itself is swelled out into a bulby form, as represented at *Fig. 3*. In this form, however, the instrument is by no means accurate, particularly when the diameter of the bulb, as is usually the case, differs but little from the diameter of the bore of the tube. In order to keep the surface of the mercury in the bason always at the same level, the father of the late Mr. George Adams constructed the bason wholly, or in part, of leather, and by means of a screw at the bottom, adjusted the surface of the mercury in it, so as to have it always at the place from which the divisions on the scale commence. In this country, the lowest station of the mercury is observed to be about 28 inches, and its highest 31 inches above the level of the mercury in the bason: and when the instrument is to remain in a fixed position near the surface of the earth, we may consider the interval between these two points as the range of the barometrical scale. The scale which consequently will embrace three inches, may be subdivided into smaller divisions, according to the degree of nicety required. Each inch is commonly divided into ten equal parts; and these are subdivided into hundredths of an inch, by a contrivance called a vernier scale. By this means the height of the mercury is ascertained, by inspection, to the $\frac{1}{100}$ th of an inch. For nice purposes, the vernier may be made to indicate the $\frac{1}{1000}$ th of an inch.

Besides these lineal divisions, the scale is divided into other points, having a reference to the instrument in its capacity of indicating the probable state of the weather. At 31 inches, the highest point of the scale of variation, *set fair* is marked on the one side, and *set frost* on the other. At 30 inches, *fair* is written, in like manner, on the one side, and *frost* on the other; and at half an inch below is written the word *changeable*, which answers both for summer and winter.

The common barometer answers sufficiently well for most purposes, when the observations are made at the same place; but as many of these necessarily imply a change of situation, it soon became an object of importance to construct barometers in such a manner that they might be conveyed from one place to another without much inconvenience or risk. Barometers of this kind, which are called portable barometers, are chiefly employed for measuring heights. They have assumed, under the hands of different artists, a variety of forms. *Figures 4 and 5, Plate VII.* represent the portable barometer as constructed by Mr. Troughton, and first made by him in 1785. The greatest peculiarity in this instrument, according to the opinion of this ingenious and philosophical artist, consists in the excellent manner in which the mercury in the cistern is set to the zero of the scale of inches. For this purpose a glass cylinder of about 2.5 inches diameter, and as much in length, contains the mercury. An external covering of hollow brass, terminating in a female screw a little above and below the glass, admits male screw pieces, whose ends, well leathered, being pressed hard against the ends of the glass, prevent the escape of the fluid. Near the upper end of the brass cover are two slits made horizontally, one before and the other behind, exactly similar and opposite to each other. At bottom is a screw which, acting upon the usual leather bag, forces the quicksilver upwards at pleasure, and by filling every part, renders the instrument portable. But the primary design of this screw is, to furnish the means of adjusting the surface of the mercury in the glass cistern, so as to shut out the light from passing between it and the upper edges of the slits in the brass cover. This is the mode of adjusting to zero; and it follows, that the upper edges of the slits must represent the beginning of the scale of inches. The frame is entirely made of a brass tube, and above the cistern is of about 1.1 inch diameter. The first ten inches of the lower end is occupied by a thermometer, whose bulb, bent inwards, is concealed within the frame. At about three inches higher, it attaches to the stand by a ring, in which the frame turns round with a smooth and steady motion, for the purpose of placing the instrument in the best light for reading off, &c. The actually divided scale commences at about 15 inches above the zero, and is continued as high as 33 inches, and, by the usual help of a vernier, is subdivided down to .001 of an inch. A longitudinal slit, from end to end of the divided part, exposes to view the glass tube and mercury within it. The whole of this part consists of two tubes of brass. In the inside of the interior one, slides a cylindrical piece, on which is divided the vernier scale, the index to which is the lower end of the piece. In taking the height of the mercury, this piece is brought down so as just to exclude the light from passing between itself and the spherical surface of the

mercury. The screw at top, although but a short one, performs this office in whatever part of the scale the vernier piece may be; for it acts upon the interior long tube, in the inside of which the piece is sustained by friction; and in which it is on every occasion to be set by hand nearly. The tripod is altogether similar to what Mr. Ramsden used for the same purpose as far back, perhaps, as the year 1775. It affords, when closed, a safe and convenient packing-case for the instrument. The structure of the staff-head is curious. The principal part is a circle (*Fig. 6.*) about .75 of an inch broad, jointed in three pieces: these, although they seem in principle to be incapable of motion, yet, in practice, produce what is fully adequate to the purpose. The three joint-pins extend inwards, so as to pass through a circular rim, which they hold fast: within this rim is hung a similar one by two pivots; and inside the latter, at right angles to the pivots, are fastened two Y's or angles, in which the barometer hangs by its gudgeons. Thus are brought about, in a small compass, the means of extending the legs, of turning the instrument about respecting the tripod, and an universal joint, whereon it readily places itself perpendicular to the horizon.

After it was observed that the different heights of the mercury served, in some degree, to indicate the state of the weather, many attempts were made to enlarge the extent of the barometrical scale, in order to measure the smallest variations in the weight of the atmosphere. These attempts soon gave rise to a considerable variety of barometers, differing in form from the common barometer, and whose scales, though less accurate, were so much increased in extent, as to point out the most minute changes in the pressure of the air.

We are indebted to Hooke for the wheel-barometer, which he invented in 1668. This form of the barometer, on account of its exhibiting the rise and fall of the mercury in a very conspicuous manner, is become extremely common. The tube is generally concealed in the frame; but, for the sake of representing the whole in one figure, we have made it to appear in front; it is about 40 inches long, but six inches of the lower end is bent upwards, so as to become parallel to the rest of the tube. As an inch of rise of the mercury in the longer leg will cause an inch of descent in the shorter, the bores being equal, the two surfaces will thus be two inches apart; and this alteration cannot be effected by a less pressure of the air than that which causes 2 inches of rise in the Torricellian tube. Hence the range of the scale is only half that of the common barometer. But this defect is compensated by converting the perpendicular motion of the mercury into a rotatory one, and exhibiting it on a circular dial plate. For this purpose, a piece of ivory of a bell form is made to float on the surface of the mercury in the shorter leg, having a silk thread fastened to its upper end, which, passing over a

pulley, is stretched by a weight that is nearly a counterpoise. By this means the motion of the mercury is communicated to an index, which turns round a graduated circle, and thus the vertical range is enlarged at pleasure.

It is extremely desirable, for meteorological purposes, to have a regular and successive series of the changes which take place in the pressure of the atmosphere during any given period; but as this would require constant attendance on the part of the observer, mechanical contrivances have been adopted for registering the indications of the barometer, and retaining them in a connected form. When the instrument is fitted up in this manner, it is called a *self-registering barometer*. The most simple kinds of self-registering barometers are such as indicate the greatest rise and fall of the mercury, or its extreme range, during any stated period; and when this only is required, the object is easily accomplished. Of this description is the self-registering barometer, invented by Alexander Keith, Esq., F. R. S., Edinburgh. It consists of a bent tube, such as ABD, Fig. 7, hermetically sealed at A. The mercury in the shorter leg supports a float, to which is affixed a slender wire terminating in a bend or knee. This knee embraces a very small wire stretched along the scale, and pushes upwards or downwards two bits of glazed silk which slide along the wire very easily, yet so as to retain the position to which they are moved by the ascent and descent of the mercury. The instrument is prepared for experiment by bringing the two bits of silk in contact with the bent knee of the float wire; the points to which they may afterwards be removed, indicate the extreme range of the mercury during the interval of any two observations. When not only the greatest and least altitude of the mercury is sought for any given time, but also its precise height at every intermediate moment, more complicated contrivances must be employed; the instrument must then consist of a barometer connected with a time-piece, and a crayon or pencil affixed to a float obeying the motions of the mercury. The greater number of self-registering barometers of this nature are so constructed, that the crayon is made to describe a continuous line on a vertical cylinder, turning on its axis by means of clock-work, and making a certain number of revolutions in some stated time. The cylinders are divided longitudinally by parallel lines into equal spaces, corresponding to some particular portion of time; and thus the line described by the crayon in that time, indicates the successive heights of the mercury during its continuance.

Oscillations of the Barometer.—Professor Loomis, in a paper on the storm of December 20th, 1836, which was read at a Philosophical society in New York, March 20th, 1840, observes that “the phenomenon, probably the most difficult of all to be explained, is the oscillation of the barometer.” And he enumerates nine causes, which have been

given, all of which he rejects, and offers a tenth, which is perhaps equally insufficient.

“1. The oscillations of the barometer,” he says, “have been ascribed to the destruction of large masses of air in the higher regions by electricity. The supposition is too gratuitous to deserve serious consideration.

“2. They have been ascribed to the diminished pressure resulting from the loss of rain. But the amount of rain which fell in the case under consideration would be balanced by a column of mercury about one fifteenth of an inch in height.

“3. Heat, by expanding a column of air, causes it to ascend to a greater height, and thus changes its centrifugal force, arising from the earth’s rotation. This cause is too insignificant to produce the effect in question.

“4. They have been ascribed to the attractions of the sun and moon. Laplace estimates the greatest oscillation of the barometer due to this cause to be at the equator, 0.025 inch.

“5. Leslie ascribes them to the centrifugal force arising from violent winds. But, in the case of a hurricane, this would not produce an oscillation of the barometer amounting to the thousandth part of an inch.

“6. The opposition of winds. This might produce a small movement of the barometer.

“7. The barometer has frequently been observed to fall under the influence of a whirlwind. But in the present case there was no whirlwind.

“8. These oscillations have been ascribed to sudden changes in temperature, and in the amount of aqueous vapour. An elevation of temperature of the entire atmosphere could not directly affect its pressure, for in proportion as its density is diminished, its height will be increased. But if, by any means, a portion of hot air can be made to displace an equal bulk of cold air, the weight of the column must be diminished. It is obvious that this cannot be a state of permanent equilibrium; yet it is worthy of inquiry whether it may not temporarily exist under the influence of winds. On the 20th of December, 1836, the air over nearly the whole of the United States became unusually heated, and its specific gravity was, of course, diminished. If, then, the height of the atmosphere remain invariable, a diminution of pressure ought to be the consequence. But, although a fall of the barometer is usually accompanied by an elevation of temperature, the reverse is sometimes the case. Thus the fall of the barometer in Europe, which, at most places, amounted to more than an inch, was accompanied by a steady fall of the thermometer. The barometer in this case fell in spite of the increased specific gravity of the air. We may naturally presume, then, that a change in the specific gravity of the air produces only a secondary effect on the oscillations of the barometer.

"9. A wind blowing upward or downward would affect the pressure of the air. This is a cause whose existence we have proved in the case in question. Its effect upon the mean pressure of the air in the equatorial regions is unequivocally maintained in the Instructions for the British scientific expedition to the Antarctic regions, recently prepared by the President and Council of the Royal society, causing the barometer at the equator to stand permanently lower than in latitude 30° , by about a quarter of an inch. The ascending current of December 20th, 1836, could not, however, exert any direct influence upon the barometer, except near the centre of the storm. To account for the entire oscillation, I think, we must admit another principle quite distinct in its operation."

Professor Loomis then comes to his final presumed cause: he says,—

"10. Let a wind blow ever so violently over the earth's surface, and the diminution of gravity arising from the centrifugal force must be inconsiderable. But, imagine the different parts of the current to travel with unequal velocity, and there will arise a mechanical condensation or rarefaction. When air is at rest, or in motion, with a uniform velocity, its particles are maintained at a constant distance from each other. But let the velocity of one section be increased beyond that of the succeeding, and the same particles of air are forced to fill a greater space. Such is the principle of the undulations which produce the sensation of sound. It appears to me that a similar effect must have been produced in the storm of December 20th, 1836. The south-east wind which accompanied the rain, moved with an accelerated velocity. The particles, therefore, of air at one extremity of the current must have left those at the other extremity at an increased distance. Hence a mechanical rarefaction, and, of course, diminished pressure. The reverse effect must have taken place after the storm had passed. A north-west wind sets in with great violence. A vast body of air is precipitated towards the south-east. The partial vacuum which at first existed is very soon supplied. Yet though the first impelling cause has ceased to act, the momentum of the excited current still urges it onward. The front of the wave is impelled by the momentum of the mass in the rear, and a mechanical condensation results, bringing, of course, increased barometric pressure. The cause, however, which produces this extraordinary rise, being temporary in its nature, soon ceases, and the barometer falls. The causes which I have here assigned for the oscillation of the barometer appear to me to be such as are known to be true, and that they are sufficient to account for the phenomena."

Mr. Green, the celebrated aeronaut, commenting on the hypothesis of Professor Loomis, in an article in the 'Journal of Meteorology,' says,—
"I now give my reasons why these causes do

not appear to me to be 'sufficient to account for the phenomena.'

"1st. The circumstance of different parts of a current of air having different velocities obtains very frequently, and is almost always observed by aeronauts, and, indeed, is known to be almost *always* the case, I may say. For at sea we set light sails aloft, and expect them to catch the breeze well, when it remains very gentle below. Hence we ought to have diminished pressure on all such occasions, which we do not.

"2d. Professor Loomis mentions that 'winds may commonly be referred to one of the three following causes: viz., 1st, Inequality of atmospheric pressure; 2d, Unequal specific gravity of air; 3d, Rotation of the earth.' And here we find 'inequality of atmospheric pressure' given as the leading *cause* of wind, while we have seen wind given, in another place, as the *cause* of inequality of atmospheric pressure. This seems to me a circular argument, and I scarcely know how to find a beginning. I agree, however, with the Professor, that when there is diminished pressure, 'the same particles of air are forced to fill a greater space.' And the question is, 'What causes them so to do?' I reply, that the presence of powerful electric currents passing from the earth into the atmosphere will produce this effect. And the consideration of it fails to present a difficulty which occurs in Professor Loomis's hypothesis, but which I omitted to describe. I allude to the fact that the decrease of pressure occurs long *before* the storm of wind, and, therefore, it cannot be any difference in the velocity of the gases moving in the atmosphere which causes that decrease; because the effect is seen before the *quasi* cause exists."

BARREL. A cask, or a small, long, narrow cylinder. A barrel of beer or ale legally contained, in former times, a quantity equal to $32\frac{1}{2}$ imperial gallons; but it now contains 36 imperial gallons. The word barrel was formerly a frequent commercial term of measure, and very widely varied in capacity according to the particular nature of the commodity. A barrel of anchovies was 50 lbs.; of barilla or potash, 200 lbs.; of gunpowder, 1 cwt.; of herrings, 32 gallons; of nuts, 3 bushels; of oil, $31\frac{1}{2}$ gallons; of raisins, 1 cwt.; of soap, 260 lbs.; and of ship beef or pork, 200 lbs. A barrel, in popular language, is any small, long, narrow cylinder, such as the tube of a fowling-piece or the body of a small cask. Watertight and air-tight iron barrels, coated with composition, have for some time past been used in the navy, and might be serviceable to the farmer.

BARREL DRAIN. See DRAIN.

BARREN CORN. See ABORTIVE CORN.

BARREN EARTH. The unstirred subsoil of any land which has long been in cultivation. But the term as thus applied, though of frequent occurrence in old books on agriculture, is a gross misnomer. Some subsoils, indeed, contain very

little matter which can nourish plants, or are even impregnated with very noxious matters, and might therefore be loosely designated barren earth; but they possess their bad properties, not at all in the capacity of subsoils, but solely in consequence of their peculiar mineral composition. No stratum of pulverulent earth, merely by lying unstirred below a long cultivated surface stratum, either is barren or becomes so; but every stratum, unless naturally possessing some poisonous ingredient, is capable, if brought to the surface, of being rendered immediately serviceable as a soil. Two main uses of all soils are to serve as the feet and legs of a plant by keeping it steady and upright, and to act as its stomach by circulating moisture and gases; and these purposes can be accomplished, in the case of most cultivated plants, by almost any pulverulent subsoil which may be brought to the surface. A third and only other chief use of soils is to afford nourishment to plants, principally from alkaline matters and from humus; and even this use—which formerly was very generally regarded as the entire function of soils—can in part be largely served by the felspathic, aluminous, and calcareous ingredients which exist in almost all subsoils, and will in remainder be fully accomplished, in most instances, by the addition of ordinary manures. The whole practice of trenching, in fact, as well as knowledge afforded by mineralogy and agricultural chemistry, demonstrates the utter nonsense of the old notion of barren earth.

BARREN FLOWERS. Flowers which can fructify but are not hermaphrodite, or flowers which either want the organs of fructification or have them not in a propagative condition. Barren flowers in the former sense are perfectly natural, and constitute three of the twenty-four classes into which Linnaeus distributed the whole vegetable world; but barren flowers in the latter sense are either maimed by art or possess a diseased or an anomalous character. The three classes of naturally barren flowers are technically called monœcious, diœcious, and polygamous,—words which mean respectively one-housed, two-housed, and many-married. Some flowers of monœcious plants contain only pistils, and some contain only stamens; but flowers of both kinds are found on the same plant. Some flowers of diœcious plants contain only pistils, and some contain only stamens; and flowers of both kinds are never found on the same plant,—some plants being exclusively pistiliferous, and some exclusively stameniferous. Some flowers of polygamous plants contain only pistils, some contain only stamens, and some contain both pistils and stamens; and flowers of all the three kinds are found on the same plant. About 850 species of monœcious plants, 660 of diœcious, and 730 of polygamous, either grow wild or are cultivated in Great Britain. Barren flowers, of the anomalous or diseased kind, are exceedingly numer-

ous, and occur in almost all the divisions of phenogamous or flowering plants; they either have an occasional existence in consequence of abortivity, or a permanence and independence of character in connexion with phytological habit; they in some cases exist in all circumstances in which their plants grow, and in other cases are produced only under unnatural or unhealthy conditions of climate, temperature, soil, or cultivation; they comprise a very large proportion of the flowers which are most admired and cultivated by florists; and, in general, they belong to all plants, whether individuals or species, which will not produce seeds, or require to be propagated by some other method than that of sowing. Familiar examples of anomalous or diseased barren flowers, are the side florets of two-rowed barley, and all the thoroughly double flowers of the flower-garden, such as those of carnation, stock, rocket, hepatica, and balsam.

BARREN LAND. See WASTE LAND.

BARREN SOILS. Soils or surface-strata which have little or no vegetation, or which cannot be reclaimed or cultivated, or which produce only poor, coarse, and scanty herbage, or which can render only meagre and unremunerating returns to the farmer. The phrase, in the first of these senses, designates absolute wilderness; in the second, perfectly waste or inaccessible morass or mountain; in the third, wild, shallow, moorland pasturage; and, in the fourth, stubborn, churlish, refractory land. Many farmers use the phrase in only the last of these senses; few use it in more than the third and the fourth; and some occasion much confusion of idea by applying it also to naturally good land in a bad condition, or, in technical phrase, to arable land out of heart. We shall use it principally as the farmers do; yet we must occasionally extend it to its more legitimate or literal meanings.

Some soils, as mere sands, mere clays, or mere gravels, are barren in consequence of the enormous predominance of only one kind of earthy matter; and most of such lie upon subsoils which are exactly like themselves, and therefore unable to furnish requisite elements of fertility. Other soils, as the surfaces of bogs, fens, and morasses, are barren in consequence, partly of over-saturation with stagnant water, and partly of the enormous predominance of unfermented, antiseptic, organic matter. Other soils, but seldom of more than very limited extent, are barren in consequence of poisonous impregnation with saline matter such as saltpetre, or of corrosive mineral matters such as the oxides of iron. Other soils, as those of portions of ill-managed farms in Great Britain and Ireland, and of many extensive tracts of country in Italy, in Asia Minor, and in Syria, are temporarily barren in consequence of the quondam extraction from them of their elements of fertility, by the most scourging husbandry, and the subsequent abandonment of them to

utter pruriency of noxious vegetation. Many soils, particularly in the mountainous regions of the world, are barren in consequence of their unfavourable geological position, or of their consisting of the debris of rocks unsuited to sustain vegetation. Clayey soils, which belong to the geognostic formations called London clay, plastic clay, wealden clay, Kimmeridge clay, Oxford clay, cornbrash and forest marble, and the coal measures, are generally barren; clayey soils belonging to the gault formation, the upper lias shale, the lower lias shale, and the lowmost lias rocks, are frequently barren; sandy and rocky soils belonging to the green sand formation, the coral rag, the new red sandstone, and the old red sandstone, are frequently barren; and sandy and rocky soils belonging to the diluvial formation, the upper chalk, the Ashburnham beds, the upper oolite, the great oolite, the magnesian limestone, the millstone grit, the carboniferous limestone, the Silurian rocks, the Cambrian rocks, mica schist, gneiss, serpentine, granite, and quartz rock, are almost always barren.

General surface appearances afford, to a practised eye, decided indications of the comparative barrenness of a district; and yet are not always useful in indicating the character of a farm or of a field. A farmer is often able to estimate at a glance the general condition of as much of a country as lies within the range of vision, when he would be totally incapable of forming a tolerable estimate of one-half of it piece by piece. When he removes from the geological formation or the particular class of soils to which he has been accustomed, he is ever liable to be deceived by colours, consistences, and other characteristics of a field which appear to the eye to resemble those of his own farm, or of farms in his vicinity, but in real mineralogical character are very widely different. The most obvious indications of comparative infertility in a district are rocky mountains, moorlands, heaths, bogs, marshes, downs, wolds, woods of beech, larch or Scotch pine, stone fences, extensive deer-parks, vast sheep-walks, much stagnant water, abundance of rabbits, abundance of bramble-bushes, furze, and black thorns, many ant-hills, numerous lapwings, plovers, and curlews, large flocks of goldfinches in autumn, and the feeding of the wild goose on stubble.

All bleak and very elevated districts are barren. Few if any naturally fertile fields occur at a greater elevation than 1,500 feet above the level of the sea. A few of the grasses, indeed, have a stunted and lingering growth at greater elevations; but most of these few are totally destitute of agricultural value. When old swardland on an elevated situation is mown, its hay-crop is both late and light; and a late hay-crop, where spring-feeding is not practised, is always an indication of comparative barrenness in the soil. Even on decidedly excellent arable land at an elevation of 1,000 or 1,200 feet, wheat, with

the common resources and management of the farmer, either will not ripen, or is of inferior quality. Yet modern agriculture has made great achievements in what is called 'high farming'; and, chiefly by means of draining, strong manuring, and improved cultivation, has produced the same effects as if mountains were deprived of several hundred feet of their elevation, or were placed several degrees nearer the equator.

The colours of barren land exhibit the utmost conceivable diversity, and are, in some instances, identical with those of fertile land. Yet certain colours, in the case of particular soils, are conclusive indications of barrenness. Nearly white thin chalk soil,—chalk soil with pale white-coloured flints,—diluvial soils with a dead white gravel near their surface,—dark-brown or nearly black moors and bogs,—moorlands with white gravel near their surface,—white silvery sands,—black sands,—pink-coloured sands,—yellow sands,—white clays,—blue clays,—yellow clays,—pink-coloured clays,—and gravelly lands whose ditches have a shining, ferruginous, or peach-coloured scum,—all these are, in every instance, barren. The colour of herbage varies so much with the season, the weather, the prevalent kinds of grasses, and other circumstances, that, except in a few very obvious cases, it cannot be regarded as an indicator of the soil. Herbage which, when growing or uncut, has the appearance of half-made hay, always consists of rough, coarse, unpalatable grasses, and indicates the land to be very bad pasture, and utterly useless for the plough. The herbage of barren land is scarcely ever green, either in spring, in summer, in autumn, or in winter, but generally appears brown or reddish-brown.

The consistency of the surface-strata of land affords, in a large proportion of instances, an excellent criterion to a practical farmer. Naked rock, pure sand, and mere clay of any depth, and coatings of mould or earth only 2, 3, or 4 inches in thickness upon any of these, are always barren. Such coatings, indeed, occasionally possess herbage of a lively green colour, well fitted to deceive the unpractised eye; but when they are pierced with a spade, or examined at any ditch, pool, or other break, their almost worthless character is readily seen. Clay soil which cuts like soap, and afterwards dries like brick,—sand which is so light as to be liable to drifting by the wind,—clays or sands which have not a large intermixture of decomposed vegetable matter,—a clay and sand soil of such texture as to be agglutinated after a brisk rain, and to take a surface like cement,—a soil of alternate layers of sand and various coloured clay,—every kind of quicksand,—a deep surface stratum of sand and gravel,—and a soil of not more than 4 inches in depth, incumbent on sand, gravel, clay, flinty or chalk rock, or dry, rubbly, slaty, or compact rock,—all these soils are, in every instance, barren.

A common practice in inspecting bad land for

valuation, is to describe its vegetation in very general terms, and without specification of any of its grasses or other plants. A valuator, for example, might say, respecting the several parts of a comparatively barren tract of land, "The herbage of one piece is of a bad quality; the bottom is mossy; the herbage of another piece is short, but sweet, and thick at the bottom; this piece will produce very tough fodder, and is coarse and benty; that piece will produce a rough, peaty, sour grass; and yonder piece is covered with poor benty herbage." But though such general notices are, in some degree, useful, an observation of the precise plants which constitute the herbage of any soils is essential to a fair knowledge of such indications of barrenness as are afforded by vegetation. Some plants invariably demonstrate the comparative infertility or worthlessness of every spot of soil on which they are found; and others demonstrate barrenness only when they occur in considerable quantities, yet sometimes indicate it when they are not abundant, and always ought at least to excite suspicion, and provoke thorough examination. Most of the plants which we shall name are of the former kind; and all ought to be readily recognisable by every person who pretends to judge of the infertility of land from the character of its herbage.

The following plants grow indigenously on very poor or almost worthless grassy lands:—*Agrimonia*, *Agrimonia eupatoria*, on dry sandy soil; rough dandelion, *Apargia hispida*, on dry barren pastures; common daisy, *Bellis perennis*, on land of all kinds from medium quality to barren, but never on good pastures; wood betony, *Betonica officinalis*, in woods and shady places; clustered bell-flower, *Campanula glomerata*, on elevated chalk pastures; round-leaved or heath bell-flower, *Campanula rotundifolia*, on heaths and dry barren pastures; the prickliest thistle, *Carduus acanthoides*, and some other species of *Carduus*, and of the genera immediately allied to it, on corn-fields, on embankments, and among rubbish; early flowering rush, *Carex praecox*, on wet heaths and poor meadows; flea rush, *Carex pulicaris*, and several other carices, particularly the well-known and much-disliked carnation grass, on boggy meadows and wet elevated grounds; star thistle, star knapweed, or blue bottle, *Centaurea calcitrapa*, on barren meadows; white goosefoot, *Chenopodium album*, on very poor cultivated land; moonflower, ox-eye daisy, or greater daisy, *Chrysanthemum leucanthemum*, on walls, road-sides, and poor, dry pastures; corn marigold, yellow ox-eye, gule, or gulegowans, *Chrysanthemum segetum*, on poor, sandy, cultivated soil; cursed thistle, or creeping plume-thistle, *Cnicus arvensis*, on bad cultivated land; marsh plume-thistle, *Cnicus palustris*, on wet clayey pastures; smooth or roof hawksbeard, *Crepis tectorum*, on walls, roofs, and bad pastures; foxglove or bloody-finger, *Digitalis purpurea*, on dry, gravelly, sandy ground;

nailwort or whitlow grass, *Draba verna*, on walls and arid places; common heath, ling, or heather, *Erica vulgaris*, on moors, in woods, and on commons; common eyebright, *Euphrasia officinalis*, on moors and dry barren meadows; cheese rennet, yellow goosegrass, or yellow ladies' bedstraw, *Galium verum*, on dry, hilly pastures; ground-ivy, alehoof, turnhoof, or catsfoot, *Glechoma hederacea*, on poor, shady spots of ground; chafeweed or common cudweed, *Gnaphalium germanicum*, on barren meadows; smooth catsear, *Hypochaeris glabra*, on sandy and gravelly soils; scabious sheep's-bit or hairy sheep scabious, *Jasione montana*, on arid grounds, on moorlands, and on sandy, barren pastures and meadows; common field rush, *Juncus campestris*, and other species of juncus, on poor, wet, spouty land; cammock, petty-whin, rest harrow, or ground furze, *Ononis spinosa*, on barren pastures; wild carline thistle, *Onopordum vulgare*, on dry pastures and meadows; hoary plantain or lamb's lettuce, *Plantago media*, on all sorts of soils, but chokes good herbage; silver weed, *Potentilla anserina*, on arid sands and on low grounds which are subject to winter floods; barren strawberry, *Potentilla fragaria*, on dry, stony, barren grounds; cowslip, *Primula veris*, on strong clayey land; primrose, *Primula vulgaris*, on clayey soils, on moorlands, and in woods and thickets; penny grass, hen-penny, coxcomb, or yellow rattle, *Rhinanthus Christa-galli*, on pastures and meadows; sheep's sorrel, *Rumex acetosella*, on gravel walks and on sandy pastures and meadows; common broom, *Spartium scoparium*, on dry pastures; coltsfoot, *Tussilago farfara*, on limestone rubbish, and on moist, stiff, clayey soil; wild thyme, *Thymus serpyllum*, on moorlands and barren alpine grounds; furze, gorse, or whins, *Ulex nanus*, on barren commons; and clafstail, black mullein, or sage-leaved mullein, *Verbascum nigrum*, on dry, sandy lands.

The following grasses grow indigenously on soils which are dry, sandy, and elevated, or which are wet, peaty, or morassy, and on which good pasture grasses, even when artificially sown on them, either will not grow, or will speedily become extinct.—Common bent, *Agrostis vulgaris*, on moors and dry pastures, not only in low situations, but so high as 2,000 feet above sea-level; brown bent, *Agrostis canina*, in patches on poor, wet, peaty soil; white-rooted bent, *Agrostis alba*, on dry, sandy meadows, and on poor dry pastures, whether low or very mountainous; creeping-rooted bent, *Agrostis repens*, on clayey soils; narrow-leaved creeping bent, *Agrostis stolonifera angustifolia*, on clayey soils, by the sides of ditches, and on cold wet mountains to the elevation of 2,000 feet; marsh bent, *Agrostis palustris*, in damp, shady, stagnant places, and on similar mountains as the preceding; rock bent, *Agrostis stricta*, on damp boggy soils; water hair grass, *Aira aquatica*, in ditches, and wet muddy places, whether hilly or champaign; tufted hair grass, *Aira caespitosa*,

in large tufts, on very coarse ground, not only in low situations, but on mountains to the elevation of 1,500 feet above sea-level; wavy mountain hair-grass, *Aira flexuosa*, on heathy and alpine ground, to the elevation of 3,500 feet above sea-level; crested hair grass, *Aira cristata*, on rocky grounds and dry pastures, to the elevation of 1,500 feet above sea-level; slender foxtail grass, or black bent, *Alopecurus agrostis*, on badly cultivated or ill-cleaned arable land; floating foxtail grass, *Alopecurus geniculatus*, in pools and on wet clayey grounds, to the elevation of 1,500 feet above sea-level; dodder, doddering toms, or common quaking grass, *Briza media*, on poor soils, to the elevation of 1,500 feet above sea-level; drank or barren brome grass, *Bromus sterilis*, on dry sandy soil and on shady ground, to the elevation of 600 feet above sea-level; soft brome grass, *Bromus mollis*, on poor, exhausted pasture ground, to the elevation of 1,000 feet above sea-level; sheep's fescue grass, *Festuca ovina*, on downs and wolds, and on dry, sandy, alpine pastures, to the elevation of 4,000 feet above sea-level; viviparous fescue grass, *Festuca vivipara*, on elevated, light, sandy soils; purple fescue, *Festuca rubra*, on sandy grounds, particularly near the sea; wood or thicket fescue, *Festuca dumetorum*, in damp woods and soft, shady places, to the elevation of 1,000 feet above sea-level; wall fescue, or tailed mouse-tail, *Festuca myurus* or *Mygalurus myurus*, in dry, barren places; smooth fescue, *Festuca glabra*, on moist pastures; wall barley, *Hordeum murinum*, on dry, light soils, to the elevation of 500 feet above sea-level; woolly soft grass, *Holcus lanatus*, on shady banks, in woods, and on moist peaty pastures, to the elevation of 1,500 feet above sea-level; creeping soft grass, *Holcus mollis*, on light sandy soil, to the elevation of 1,500 feet above sea-level; wild sainfoin, *Hedysarum onobrychis*, on dry, barren, chalky pastures; purple melic grass, *Melica cærulea*, on moors, peat bogs, and damp heathy places, to the elevation of 1,500 feet above sea-level; upright mat grass, *Nardus stricta*, on dry moors and alpine heathy grounds, to the elevation of 4,000 feet above sea-level; lesser meadow catstail grass, *Phleum pratense minus*, on very stiff, clayey land; alpine meadow grass, *Poa alpina*, on lofty mountains, to the elevation of 4,000 feet above sea-level; and flat-stalked meadow grass, *Poa compressa*, on mountains, to the elevation of 3,000 feet above sea-level.

BARRENWORT,—botanically *Epimedium*. A small genus of ornamental plants of the barberry tribe. The alpine species, *Epimedium alpinum*, is a creeping deciduous perennial, and grows wild in mountainous thickets of Great Britain,—particularly in Yorkshire, in Cumberland, and in the vicinity of Edinburgh and Glasgow. Its root is creeping; many stems rise from one root, and attain a height of about 9 inches; each stem divides at the top into three branches, and each branch into three sub-branches; a leaf stands upon each sub-branch, stiff, heart-shaped, ending

in a point, pale green above and grey below; a floral footstalk comes out a little below the first division of the stem, and divides into smaller footstalks; and a flower is produced from each of the smaller footstalks, and has four cruciform petals, of a dark red colour in their body, with yellow stripes on their border. The flowers have a clustered, drooping, and very handsome appearance; their nectaries are peculiar in form, and very rich in honey; and their incipient seed-vessel becomes a slender pod, containing many oblong seeds. The plant blooms in April and May; and if kept in the shade, may be made to flourish till August. One curious species, the six-stamened, was recently introduced from North America; and three somewhat handsome species were introduced a few years ago from Japan.

BARROW. An implement of land carriage. Yet the name is so very loosely and extensively applied as to designate any one of numerous implements of carriage, two-wheeled, one-wheeled, and wheelless. A two-wheeled barrow for ordinary out-of-door carriage is shaped nearly like a miniature cart, with the addition of two supporting feet; and, when about a yard in diameter, is extremely convenient for the carriage of small loads either in cities or upon farms. A common one-wheeled box barrow may be of various shapes and sizes, and either light or heavy; and is an indispensable implement on the mimic establishment of a cottage-farm, and a very useful implement in much of the home carriage of a large farmery. A light-sparred open one-wheeled barrow is the most economical and convenient implement for conveying the corn of a rick from the rick-yard up the gangway into the threshing-barn. The two-wheeled load-barrow, with small, low-wheels, fixed with their axle near the lower and scooped extremity of the machine, is eminently servicable for moving full sacks of grain in the corn-barn, in the granary, or in flour-mills. A box hand-barrow, carried between two men, is sometimes necessary for carrying earth or manure on wet land; and an open hand-barrow is used, on very many farmeries, for conveying farm-yard manure from the cattle-houses to the dung-heap.

BARROW. A tumulus or huge mound of earth, raised, in ancient times, over the body of a warrior. Many ancient barrows still exist on the plains of Wiltshire, on the hills of Surrey, Sussex, and other English counties, and among the valleys, glens, and mountains of Scotland.

BARS. The portions of the hoof-sole of horses, which are reflected inwards, and which form arches between the frog and the quarters. The bars of the mouth are the fleshy rows which run across the mouths of horses, and reach almost to the palate. The bars of the mouth are very distinguishable in young horses.

BAR-SHOE. A horse-shoe of particular construction, adapted to a tender foot, and designed to protect a sore or weak point from pressure, by

causing the whole weight of the limb to be borne by the other portions of the sole. Its chief feature is a continuation of the common shoe round the heels; and its principal use is in cases of corn, sand-crack, and pumiced feet; but it requires to be made thick, and sometimes presses very injuriously on the heels.

BARTH. A warm enclosure or sheltered pasture for calves or lambs.

BARTON, or BARKEN. The yard of a farmhouse.

BARTSIA. A genus of ornamental annual plants, of the figwort tribe. Three species are natives of Great Britain;—the viscous, growing in marshes, and having a yellow flower; the alpine, growing beside mountain streams, and having a purple flower; and the odontites, growing on meadows and pastures, and having a pink flower. They grow to the height of from 6 to 9 inches, and bloom in July.

BARYTES. The name of one of the earths; from a Greek word signifying *heavy*, on account of the great weight of its acid combinations. It is procured either from the native sulphate of barytes, by exposing its powder to a red heat with charcoal, and by forming from the resulting sulphuret a nitrate, which is decomposed by heat; or from the native carbonate, by dissolving it in nitric acid, and, in like manner, subjecting it to heat. Thus obtained, barytes has a specific gravity of 4, is of a grey colour, has a caustic taste, and slakes on exposure to the air, like lime, falling to powder from the absorption of water. It is soluble in 25 parts at 60°, and in the proportion of nearly half its weight at 212°. The solution, on cooling, affords prismatic crystals. Its watery solution possesses, distinctly, alkaline properties, changing the vegetable blues to green, and acquiring a film upon its surface, when exposed to the air, from the absorption of carbonic acid. It operates as a virulent poison when taken into the stomach. To the flame of alcohol it imparts a yellow colour, which, together with its great solubility in water, serves to distinguish it from the other earths. It is useful in chemical analysis, in consequence of its property of uniting by fusion with several of the earths and metallic oxides, and rendering them soluble in acids or water. Barytes has been decomposed by the agency of galvanism, and ascertained to be the oxide of a peculiar metal, to which Sir Humphrey Davy has given the name of *barium*. It has a white colour, with a metallic lustre, resembling that of silver. Exposed to the air, or thrown into water, it absorbs oxygen, and is converted into barytes.—It combines with the acids, and forms a variety of salts, two of which, the carbonate and the sulphate, are found abundantly in nature. The first of these is called, in mineralogy, Witherite, from Dr. Withering, its discoverer. It is commonly fibrous or bladed in its structure, occasionally including small cavities lined with minute crystals. It is whitish, translucent, and

glistening. Specific gravity, 4.3. It is composed of barytes, 78, and carbonic acid, 22. Like all other salts of barytes (with one exception), the carbonate is a virulent poison, and has often proved fatal to domestic fowls and animals who have accidentally swallowed it, about the mines where it occurs. Its principal localities are in the north of England, where it is found in lead mines: it also occurs in Styria, Salzburg, and Siberia. It is used to obtain the pure barytes, and those salts of this earth which are employed as chemical tests, and for the purposes of scientific illustration.—The sulphate of barytes, called, in mineralogy, *heavy-spar*, is found abundantly in almost every country, usually accompanying galena, or common lead ore, of which it frequently forms the gangue. It is often beautifully crystallized under a variety of forms, derived from a right rhombic prism of 101° 42', and 78° 18', but is more generally lamellar or compact. It presents numerous colours, of which white is the most frequent. It is translucent, and sometimes transparent, capable of being scratched by the knife, and of a specific gravity of 4.7. Like the artificial sulphate of barytes, it is insoluble, and is the only salt of this earth which is not poisonous. It consists of 67 parts barytes, and 33 sulphuric acid. It is employed, though less extensively, for the same purposes as the carbonate, and was formerly used, by Mr. Wedgwood, in the manufacture of his beautiful jasper ware.—A fibrous variety of heavy-spar, called *Bolognian stone*, and which occurs, imbedded in small nodular masses, in a marl near Bologna, has the remarkable property of becoming phosphorescent by calcination.—The artificial sulphate of barytes formed by adding sulphuric acid to the carbonate of barytes, is employed for the purpose of painting in water-colours, and is the most beautiful white now in use. It is known by the name of *Permanent white*. The same substance is much valued for marking bottles in chemical laboratories, where the acid vapours destroy common ink, and for labelling articles kept in cellars and moist places. In order to be applied, it is mixed up with spirits of turpentine and linseed oil, to the consistence of common paint, when it is laid on with a brush. If a black marking material is preferred, this may be rendered so by the addition of a little lampblack. The *nitrate of barytes* is formed by dissolving the native carbonate in diluted nitric acid, and crystallizes on evaporation. It is soluble in 10 or 12 parts of water, at 60°, and in 3 or 4 parts at 212°.—The *muriate of barytes*, in like manner, is produced by submitting the carbonate to the action of dilute muriatic acid. It is much more soluble than the nitrate. Solutions of both these salts are of great importance in analytical processes, for the detection of sulphuric acid; the barytes forming, with that acid, an insoluble precipitate, while the nitric or muriatic acid neutralizes the base. The muriate of barytes is employed with advantage as a medi-

cine, in the treatment of scrofulous diseases, though, from its poisonous nature, great caution is requisite in its administration.

BASALT. A rock of igneous origin, and very extensive occurrence. The colour of this rock is dark greyish black, or brownish grey. It is found in large shapeless masses, or in columnar prisms, with from three to nine faces. These columns are of all sizes, from a few inches to several feet in diameter, and sometimes four hundred feet in height. They are composed of joints, or blocks of the same angular shapes, resting one upon another. The texture of basalt is fine grained, or compact, and it consists of an intimate mixture of a number of other minerals, among which may be distinguished augite or hornblende, labradorite or nephelin, magnetic and titaniferous iron ore, olivine and one or more zeolites, all of which often occur separated in the basalt. C. Gmelin was the first to show that basalt consists of two portions, one of which is decomposable by acids, the other not. All later chemical investigations have been based on this fact, but without yet being able to separate or distinguish, with sufficient accuracy, the different minerals of which it is composed; for, if a dilute acid be employed, olivine and magnetic iron ore are only imperfectly decomposed, while, by a stronger acid, portions of augite and labradorite are, at the same time, also attacked. From the same reason, it is also difficult to determine the particular species of zeolite which it contains. Basalt is distinguished from lava by its content of water, which averages about 2.5 per cent., and of which lava only contains hygroscopical portions.

BASE, or BASIS. Any substance capable of combining with acids, and neutralizing more or less their acid properties, and thus forming salts with them. Every true salt, therefore, consists of an acid and a base, or, in electro-chemical language, of an electro-negative and electro-positive ingredient: see article **SALTS**. The alkalies possess, therefore, in the highest degree, the character of bases, and the latter word is only a wider extension of the term alkali, from the supposition that the alkaline ingredient of a salt constituted its most important and characteristic part, or the basis of it. For the same reason, the term basis is often, but less frequently, extended to the electro-positive element of the alkalies themselves, or of any other binary compound, in which latter sense it becomes synonymous with *radical*; thus, potassium is said to be the metallic *basis* or radical of potassa (oxide of potassium) and of chloride of potassium. As the term *salt* was extended beyond oxysalts to other ternary compounds, such as sulpho-salts, chloro-salts, &c., it has also become necessary to extend the term base to the electro-positive ingredient in these salts, and we thus distinguish between oxy-bases, sulpho-bases, chloro-bases, &c. Thus, oxide of copper is an oxy-base, because it combines with oxacids, such as arsenic acid, forming an oxysalt,

the arseniate, or more correctly, the oxy-arseniate of copper; while the sulphuret of copper is a sulpho-base, combining with sulph-acids as, for instance, with sulpharsenic acid to a sulpho-salt, the sulpharseniate of copper. Under the term oxybases, or simply bases, as they often are called, where no reference is made to other kinds of bases (such as sulpho-bases, &c.), are, therefore, comprehended the alkalies, the alkaline earths, the earths, and generally all those oxides which are capable of combining with, and more or less neutralizing oxacids, and forming salts with them, such as the oxides of iron, copper, &c., for which we refer to the different metals. To this class of bases belong also a class of organic, nitrogenous substances mostly obtained from plants, or artificially produced, which have all the properties of the metallic or inorganic bases, and are capable of replacing them in their combinations. These are termed *vegetable alkalies* or *alkaloids*: see **ALKALOID**. But their character as oxides or oxybases is even more doubtful than that of ammonia (or oxide of ammonium), with which they seem to have an analogous constitution, while their basic properties, at the same time, seem dependent on the amount of nitrogen which they contain. The oxides of ethyl (ether) and methyl form another class of organic bases, which may be combined with acids and neutralize their acid properties, and are therefore also called organic bases, but their combination with the acids differ considerably in their nature from the ordinary inorganic salts by not allowing their acids or bases to be replaced or exchanged, with the same facility, by single or double affinity for other bases or acids.

BASELLA. A genus of tender twining plants, of the goosefoot tribe. Five species, the white, the red, the black, the shining, and the heart-leaved, are cultivated for various purposes in India and China; and two species are grown as ornamental stove plants in Great Britain. The kind longest known in Britain has a strong, thick, succulent stem, and deep purple-coloured leaves; and is popularly called climbing nightshade or Malabar night-shade. The juice of the berries yields a beautiful but fugitive dye.

BASIL.—botanically *Ocimum*. A genus of plants, of the lip-flowered tribe. The common basil, usually called sweet basil, *Ocimum basilicum*, is a tender, aromatic herb, used for soups, salads, and other culinary purposes, and particularly noted for imparting to mock turtle soups their peculiar grateful flavour. It is an annual, and a native of India, and was introduced to Great Britain about the middle of the 16th century. Its stem is branching, hairy, quadrangular, and about a foot in height; its branches are hairy and quadrangular, and are produced in mutually opposite pairs, all the way up the stem; its leaves are oval, spear-shaped, dentated, and ending in acute points; and the whole plant has a strong aromatic flavour similar to that of cloves. Its principal varieties are common basil, with

very dark green leaves, and a violet-coloured flower; curled-leaved basil, with short spikes of flowers; middle basil, with a citron flavour; studded-leaved basil; and basil, with leaves of three colours. All the varieties are propagated from seeds sown in March on a moderate hot-bed; and the young plants are first transplanted into another moderate hot-bed, and afterwards, in May, are removed, with balls of earth, to the open ground.—The greater or clove-scented basil is very generally regarded as a variety of the common basil; but it is larger in size, and possesses some observably different characters. Its stem rises to the height of 18 inches; its leaves are large, oval, and smooth; and its flowers are produced in whorled spikes of 5 or 6 inches in length from the top of the stem, and in smaller whorled spikes from the ends of the branches; but, in all other respects, it closely resembles common basil. Its principal varieties are the purple fringed-leaved, the green fringed-leaved, the large-leaved, and the green studded-leaved.—The least basil, or bush basil, *Ocimum minimum*, is a low bushy annual of from 6 to 12 inches in height. Its branches spread out from the lower as well as the upper parts of the stem; its head has an orbicular outline; its leaves are small, oval, and smooth, and stand opposite to one another on short footstalks; and its flowers are produced in whorls toward the top of the branches.—The hoary and the pilose species are annuals of similar habits to the common species, but are not cultivated in the kitchen garden. Fifteen or sixteen other species, some annual, some biennial, some perennial, and all tender, are grown in Great Britain; but, excepting three or four which rank as ornamental plants, they are quite devoid of interest.

BASIL (WILD).—botanically *Clinopodium*. A genus of hardy, perennial, herbaceous plants, of the lip-flowered tribe. The common species, *Clinopodium vulgare*, grows wild by the side of hedges and in thickets, in most parts of England. Its root is fibrous, and sends up several stiff square stems to the height of 18 inches; the branches are produced laterally near the top of the stems; the leaves are oval, hairy, and in mutually opposite pairs; and the flowers are produced in whorls or heads, one at the top of the stem, and generally one also at the joint next the top. Some of the flowers are purple, others are white, most are pink, and all appear from June till August. The plant is slightly aromatic, has a fragrant and refreshing odour, grows luxuriantly under culture, and is well-known in kitchen gardens. Two other species are cultivated in Britain, the Egyptian and the origanum-leaved, the former from Egypt, and the latter from the south of Europe.

BASIL THYME.—botanically *Acynosa vulgaris*. An indigenous, ornamental, annual plant, of the lip-flowered family. It was formerly regarded as a species of thyme, and called *Thymus acynos*.

It has a height of only 6 or 8 inches; is spreading and much branched; its leaves are acute, serrated, and slightly aromatic; and its flowers grow in whorls, and have a bluish colour, tipped with white and dark purple. The plant frequently occurs in cultivated fields, and at the foot of dry hedges; and is specially luxuriant on sandy, gravelly, and chalky soils.

BASILICON. An ointment, made of resin, bees' wax, and olive oil. It is a good digestive ointment for cattle wounds which will not readily heal; and, when a little turpentine and verdigris are added to its composition, it acts as a good stimulant.

BASIN, or BASON. A reservoir or artificial pond, for the retention of water in a garden, or on the home-ground of a farmery, for either use or ornament.

BASKET. A utensil for holding dry goods, or a vehicle for their hand-carriage. Baskets are made generally of the twigs of willows, but sometimes of the twigs of birch, hazel, and other elastic brushwood, splinters of elastic timber, culms of strong grass, and stems of rushes and other soft filamentous plants. They are constructed likewise of a great variety of shapes and sizes, and for a vast multiplicity and diversity of uses. Most of the multitudinous baskets of the regular basket-maker, are too ornamental and costly to suit the purposes of a farm; but numerous coarse kinds of osier baskets, from the small fruit pottle to the large potato basket, or the still larger pannier, are of eminent service. They are too well known, however, to need any description.

BASS. The material of packing-mats, used in stripes for ligatures to growing plants. Any gardener who cannot readily obtain a supply of bass, may easily prepare it for himself from the loppings of lime-trees. Any branches of lime-tree, from an inch in diameter to the largest obtainable size, may be steeped three months in a ditch or pond, and afterwards dried; and their bark, if it then be peeled off in stripes, and washed in clean water, will be found to be very strong and tough bass.

BASSIA. A small genus of tender, evergreen trees, of the sapota tribe. Three species, the long-leaved, the broad-leaved, and the butter-bearing, have been introduced to Great Britain, the last from Nepaul, and the other two from Hindostan. All grow to the height of about 40 feet, and have a beautiful appearance. Their flowers are sweet, singular-looking, and useful; they are collected in great quantities, and used for various purposes, in many parts of India; in Tranquebar, they are bruised, boiled to a jelly, formed into balls, and bartered by the natives for rice and fish; in Bahar and some parts of the Circars, they are dried in the sun, till they acquire a flavour like raisins, and are sent over all the Mahratta countries, in the same manner as raisins are in Europe; and at Chatra, in various other parts of Upper India, and in some districts

of Lower Hindostan, they are used for the distillation of spirituous liquors. An expressed oil is obtained from the olive-shaped seeds of the five-celled fruit of *Bassia longifolia*, and is used by the common people of India, for burning in lamps, for the making of soap, and as a substitute for ghee. A similar produce of the Nepaul species is alluded to in its specific name of butter-bearing. The juice of the bark of the long-leaved species is prescribed by Indian practitioners in cases of rheumatism. The timber is used for house-building, for doors, windows, and other purposes.

BASTARD. The Romans distinguished two kinds of natural children—*nothi*, the issue of concubinage, and *spurii*, the children of prostitutes; the former could inherit from the mother, and were entitled to support from the father; the latter had no claims whatever to support. *Is non habet patrem, cui pater est populus.* The Athenians treated all bastards with extreme rigour. By the laws of Solon, they were denied the rights of citizenship. A law of Pericles ordered the sale of 5,000 bastards as slaves. What rendered these regulations more severe was, that not only the issue of concubinage and adultery, but all children whose parents were not both Athenians, were considered bastards at Athens. Thus Themistocles, whose mother was a native of Halicarnassus, was deemed a bastard. The law, as might be expected, was often set aside by the influence of powerful citizens. Pericles himself had it repealed in favour of his child by Aspasia, after he had lost his legitimate children by the plague. The condition of bastards has been different in different periods of modern history. Among the Goths and Franks, they were permitted to inherit from the father. Thierry, the natural son of Clovis, inherited a share of his father's conquests. William the Conqueror, natural son of Robert I., duke of Normandy, and of Arlette, daughter of a furrier of Falaise, inherited his father's dominions. He called himself *Willemus, cognomento Batardus*. The celebrated Dunois styled himself, in his letters, 'the bastard of Orleans.' In Spain, bastards have always been capable of inheriting. The bastardy of Henry of Transtamare did not prevent his accession to the throne of Castile. In France, the condition of bastards was formerly very different in the different provinces. Since the revolution, it has been regulated in a uniform manner by the general law of the kingdom. The *Code civil* thus fixes their rights: If the father or mother leave legitimate descendants, the bastard is entitled to one-third of the portion he would have inherited had he been a lawful child; if the father or mother die without descendants, but leave ascendants, or brothers or sisters, then he is entitled to one-half of such a portion; if the father or mother leave no ascendants nor descendants, nor brothers nor sisters, he is entitled to three-quarters of such a portion; and if the

father or mother leave no relations within the degrees of succession, he is entitled to the whole property. These regulations do not apply to the issue of an incestuous or adulterous connexion. The law allows no civil privileges to individuals who owe their existence to the violation of human and divine laws; it grants them only support. According to the ancient customs, the bastards of kings, acknowledged by their fathers, were princes; those of princes were gentlemen. Several distinguished men, and fabulous heroes, have been bastards—William, who conquered England; Dunois, who delivered France; the duke of Vendôme, the duke of Berwick, the marshal Saxe; Bacchus, Hercules, and Romulus.

By the common law of England, a child born after marriage, however soon, is legitimate, or at least he is presumed to be so; for one born in wedlock, and long enough after the marriage to admit of the period of gestation, may still be proved illegitimate, in case of absence and non-access of the husband, and under some other circumstances. According to the common law, a bastard is not the heir of any one; and, on the other hand, his only heirs are his children born in wedlock, and their descendants. According to the Roman law, one born out of wedlock might be legitimated by subsequent marriage and acknowledgment of his parents. In 1236, the English prelates proposed the introduction of the Roman law, in this respect, into England, to which the nobility made the celebrated reply, *Nolumus leges Angliæ mutare*,—"we are unwilling to change the laws of England."

The principal statutes wholly or partly in force on the subject of bastardy before the 14th of August, 1834, were 18 Eliz. cap. 3; 7 Jac. I. cap. 4; 6 Geo. II. cap. 31; 35 Geo. III. cap. 101; 49 Geo. III. cap. 68; 50 Geo. III. cap. 51; 54 Geo. III. cap. 170. The only object of affiliation as recognised by these enactments is indemnity to the parish for the charges of maintenance of a bastard. Ulterior views of compensating the woman for the injury inflicted on her, or punishing seduction by throwing a burthen on the father, are not anywhere to be discovered. In the whole of the law, as it existed prior to the 4 and 5 Will. IV. cap. 76, there is no trace of those enactments for the punishment of seduction, and that compassionate regard for the frailty of the weaker sex which the Poor-law amendment act is by many persons supposed to have so mercilessly and recklessly blotted out of the statute-book. "That statute," says Sir Edmund Head, whose report on the law of bastardy we are now abridging, "removed certain penalties from the mothers of chargeable bastards, and on the other hand imposed on them obligations to which they were not formerly subject. It abolished the punishment of imprisonment for having an illegitimate child chargeable to a parish; and by causing the child to follow the settlement of its mother, conferred a still greater boon upon

her, as it put a stop to the practice of hunting an unfortunate woman from parish to parish when in the last stage of helpless pregnancy. To use the language of the minute of the Poor-law commissioners of the 5th of March, 1833, the amended law removed the punishment which placed such conduct in the class of *crimes*, and simply left the mother to bear the natural consequences of *vice*: these consequences are the burthen of supporting the child. The woman who has neglected to take the precaution of securing by the legal and religious sanction of marriage a protector for herself and her offspring, is most properly supposed to assume the duties of a mother without the rights of a wife. But it is objected immediately, that you call on her to do what she cannot do, viz., to maintain her child. If this be so, the law does not deny her relief. The condition of entering the workhouse is usually imposed as a security against wilful chargeability in this as in many other cases, but the same relief which is extended to destitution of other classes is not denied to the mother of an illegitimate child. It is true, that by the 71st sec. of 4 and 5 Will. IV. cap. 76, all relief granted to the child is declared to be granted to the mother, and the child made a part of her family. The result of this clause is merely that the mother of a bastard is put on one and the same footing with destitute widows. Previously she was far more advantageously situated. She might separate her fate from that of her offspring; if relief in the workhouse was offered to the child she could refuse to go in. If she ran away and left her illegitimate child chargeable, the Vagrant act was not applicable to her case, for a bastard was not legally part of her 'family,' while a widow for a similar act might have been treated as a criminal.

"However, it is not perhaps the law as it existed before 1834 which is regretted, so much as the spirit in which it was administered. The principal ground of complaint against the Poor-law amendment act, on the part at least of those who know what the law was before and after that statute, is the change which is effected in the facility for affiliating bastard children. The fictitious chargeability, the *ex parte* proceeding against the putative father, and the power to two justices to make an order, were abolished. In their place was substituted a mode of affiliating at the next practicable quarter-sessions after chargeability, but without any power to recover the expenses; corroborative evidence was required; the order could only be made after fourteen days' notice to the putative father, and it remained in force only until the child was seven years of age, if it was so long chargeable. No part of the money thus levied from the putative father could be paid to the mother. It is difficult to conceive anything less consonant to the principles of English jurisprudence than the proceedings under the 6 Geo. II. cap. 31, and 49 Geo. III. cap. 68:

imprisonment was summarily inflicted on the unsupported oath of an interested person; the whole proceedings were *ex parte*; no summons was required, and no opportunity for confronting the accuser was deemed necessary before commitment. I do not wish my meaning to be mistaken," continues Sir Edmund. "The impunity of a father of a bastard (assuming that we can ascertain who he be) is an evil, and a considerable evil; but, whatever our sympathy with the woman may lead us to wish, I much fear that it is one from which we cannot escape, except at the sacrifice of something still more valuable. Like most things in human affairs, there is not unmixed good on either side; the question is, on which there is the greater danger. The risk is undoubtedly very much diminished by enforcing strictly the relief to the mother by admission into the workhouse, with her child, and by no other means. She can then, if driven to extremities by the refusal of the putative father to provide for or marry her, bring the penalties of the law on his head, only by making a considerable sacrifice herself. This consideration brings me to the subject of which much is heard at boards of guardians—the hardship on the rate-payers of causing them to support two persons instead of one. The woman may be able to earn her own living, if relieved of her child. The child was, under the old system, put out to nurse by the overseers, at 1s. 6d. or 2s. a-week, and the burthen on the parish apparently lightened. The mother, thus placed in a much better situation than a widow, free from all trouble and all maternal obligations, generally went out to service, perhaps as a nurse, and, within a certain time, contrived to convince the rate-payers that she was not insensible of the advantages which they had provided for her. This is the system which, on the score of economy, is often regretted. The good sense of the public in this country has rejected the institution of those foundling hospitals common on the continent; but, at the same time, it thus tacitly submitted to an arrangement which turned the whole country into one large foundling hospital.

"Mr. Laing, in his recent tour in Sweden, gives most instructive evidence as to the number and causes of illegitimate births in that country. It appears that the proportion of illegitimate to legitimate births in all Sweden, from 1820 to 1830, is as 1 in 14½, and in Stockholm as high as 1 to 2½. Mr. Laing goes on to remark:— 'There are two minor causes, both, however, showing a degraded moral feeling, which were stated to me as contributing much to this lax state of female morals. One is, that no woman in the middle or higher ranks, or who can afford to do otherwise, ever nurses her own child. A girl who has got a child is not therefore in a worse, but in a better situation, as she is pretty sure of getting a place for two years, which is the ordinary time of nursing. The illegitimacy

of the child is in this community rather a recommendation of the mother, as the family is not troubled with the father or friends. As to the girl's own child, there is a foundling hospital, the second minor cause; in that it can be placed out, at a trifling expense, for the time the mother is out nursing. The unchaste are therefore, in point of fact, better off than the chaste of the female sex in this town.' It is well known that the results of the unrestricted reception of bastard children into the foundling hospitals in Belgium made it necessary for the government to take steps, in 1834, for discouraging the operation of, if not for repealing, the law under which it took place. The legislation of the French republic, by the laws of 27 Frimaire an V. and 30 Ventose an V., explained by an edict of 19 January, 1811, was most favourable to the mothers of bastards, and relieved them from all care of their own offspring. M. de Beaumont says,—“On sait qu'une loi de la révolution récompensait les filles mères d'enfants naturels.” Under the influence of these laws, which only carried out the principle involved in our former practice, the illegitimate children increased from $\frac{1}{7}$ (which they were, on an average of seven years, in 1780) to $\frac{1}{4}$, in 1825. Malthus (vol. i. p. 375) reckons the illegitimate births in France, at the time he was writing, as $\frac{1}{4}$ of the whole.

“It appears that in 1838 the number of births in Paris was

29,743 $\left\{ \begin{array}{l} 20,454 \text{ legitimate,} \\ 9,289 \text{ illegitimate.} \end{array} \right.$

The illegitimate were therefore 31·2 per cent., or, to the legitimate, as 1 to 2·2, a proportion larger than that existing at Stockholm.

In the whole of France, in 1837,

The total number of births $\left\{ \begin{array}{l} 873,520 \text{ legitimate,} \\ \text{was } 943,349 \quad \quad \quad \left\{ \begin{array}{l} 69,829 \text{ illegitimate.} \end{array} \right. \end{array} \right.$

That is 7·4 per cent., or as 1 to 12·5.

The ‘mouvement moyen’ of the population, calculated on the twenty-one years from 1817 to 1837, gives as the annual number of births

968,752 $\left\{ \begin{array}{l} 899,451 \text{ legitimate,} \\ \quad \quad \quad \left\{ \begin{array}{l} 69,301 \text{ illegitimate.} \end{array} \right. \end{array} \right.$

That is the illegitimate to the legitimate as 1 to 12·979.

“It thus appears that the proportion of illegitimate births is greater in France than in Sweden, the former being as 1 to 12·979, and the latter as 1 in 14 $\frac{1}{2}$, according to Mr. Laing, while the morality of France would seem to have deteriorated since the calculation of Peuchet. I fear that there are rural districts in this country in which the proportion of illegitimate to legitimate births is far more unfavourable than that existing in the French empire. The population of the county of Radnor, in 1831, was 24,661. According to Mr Rickman, the number of baptisms registered in 1830 was

649

26 add for unentered births and baptisms.

675 total.

“The number of illegitimate children born in 1830 is stated, on the same authority, to be 100; that is to say, 1 in 6·75! or more than twice as many in proportion as in France. This will not seem incredible when we find from the table published in the appendix to the second annual report of the Poor-law commissioners, that the average annual number of bastards chargeable to the parishes of the county of Radnor, in 1835 and 1836, was 417, or $\frac{1}{25}$ of the whole population of the county, according to the census of 1831; and it is not to be wondered at that there are at present 15 women with bastard children inmates of the workhouse of the Knighton union, of which the population is only 8,719 (census 1831).”

The chief distinction between the English and Scotch bastardy laws consists in this,—that in England the putative father of an illegitimate child can only be required to contribute towards its maintenance in case it becomes chargeable to a parish, so that the bastardy laws are inseparably connected with the poor laws; whereas in Scotland the putative father is liable without any such previous chargeability, and it is only indirectly and occasionally that the poor laws are brought under consideration at all, as connected with the bastardy laws. The mother of an illegitimate child in Scotland may at once bring an action for aliment in the sheriff's-court against the putative father; and if she proves her case, the sheriff decrees that the father shall pay a certain sum yearly for the maintenance of the child,—until seven years of age if it is a boy, and until ten years of age if it is a girl. The sum thus decreed by the sheriff is a debt to the mother, and can be recovered in the same way as any other debt under the Scotch laws. The parish interferes very rarely in behalf of the mother. The oath of the woman may be received against the putative father, provided that some other evidence tending to inculpate him is previously adduced. This evidence is technically called *semip'ena probatio*, and may be regarded as substantially the same as the “corroborative evidence” in the English law.

BASTARD ACACIA. See ACACIA-TREE.

BASTARD ALKANET. The annual weed Corn Gromwell, or *Lithospermum Arvense*. See GROMWELL.

BASTARD BALM. See BALM (BASTARD).

BASTARD BOX. A low, evergreen, hardy trailing plant, of the milkwort genus,—*Polygala chamaebuxus*. It is a native of Austria.

BASTARD CEDAR,—botanically *Cedrela*. A small genus of tender evergreen trees, of the melia order, and forming the type of a tribe which comprises six genera. Three species, the sweet-scented, the velvety, and the Toona tree, have been introduced to Great Britain; all grow to the height of about 50 feet; and the sweet-scented and the Toona tree are held in esteem as timber-trees, the former in the West Indies, and the latter in Hindostan. The timber of the

Toona tree is beautiful, has a grain and colour similar to mahogany, and is made into all kinds of furniture. The flowers of this tree are employed, along with those of safflower, for producing a beautiful red dye.—The name bastard cedar is given also to a small genus of tender evergreen trees, of the byttneria family. This genus is now called by botanists *Guazuma*, but was formerly called *Bubroma*. The elm-leaved species, *Guazuma ulmifolia*, is a timber-tree of Jamaica, and grows to the height of about 40 feet. Two other species are ornamental trees of about 20 feet in height, and natives of tropical South America.

BASTARD CHERRY. See CHERRY.

BASTARD HYSSOP. A hardy, ornamental, tuberous-rooted plant, of the germander family. —*Teucrium pseudo-hyssopus*. It grows to the height of about 18 inches, and produces a white flower in June and July.

BASTARD INDIGO. See AMORPHA.

BASTARD TOADFLAX, — botanically *Thesium*. A genus of perennial, herbaceous plants, of the sandal-wood family. The flax-leaved species, *Thesium linophyllum*, grows wild on the chalky pastures of England. Its stem is erect, angular, leafy, much ramified, and about half a foot in height; its leaves are light-green, rough-edged, about an inch in length, and turned to one side; and its flowers have a whitish colour, are produced in terminal clusters, and appear in June and July. Upwards of thirty other species are known to botanists; but all are exotic and uninteresting.

BASTARD-VETCH, — botanically *Placa*. A genus of hardy herbaceous plants, of the pea family. About 15 or 16 species are grown in Great Britain; but all are exotic, only two or three are ornamental, and none are suitable for field cultivation. Most are natives of Siberia and the north of Europe. One of the Siberian species has been very long cultivated in British gardens. Its roots run very deep into the ground; its stems are ligneous, annual, and nearly four feet high; and its flowers are produced in short spikes from the wings of the leaves.

BAT. A mammiferous quadruped, of which there are numerous genera, species, and varieties. The bats constitute the first family of the order Carnivora; and are peculiarly distinguished by the elongation of their anterior extremities, which are expanded, and, by the intervention of a delicate membrane between the fingers, converted into wings. This membrane also includes the hind legs, of which, however, the toes are not similarly developed, and extends to the tail. In consequence of this organization, they are technically named *Cheiroptera*. These animals live chiefly on insects, are of nocturnal or crepuscular habits, fly with a fluttering kind of motion, betake themselves by day to caves, crevices, and retreats of a similar nature, and in cold climates become torpid during a great part of the winter.

Some of the larger tropical species are frugivorous. They vary in size from that of the smallest common mouse up to that of the gigantic ternate bat, whose body is as large as that of a squirrel. The smaller species are abundantly distributed over the face of the globe; the larger appear to be confined to warm and hot regions, where they exist in great numbers, and are very destructive to the fruits. The purely insectivorous species render great service to mankind by the destruction of vast numbers of insects, which they pursue with great eagerness in the morning and evening twilight. During the day-time, they remain suspended by their hooked hinder claws, in the lofts of barns, in hollow or thickly-leaved trees, &c. As winter approaches, in cold climates, they seek shelter in caverns, vaults, ruinous and deserted buildings, and similar retreats, where they cling together in large clusters, and remain in a torpid condition until the returning spring recalls them to active exertions. We here observe the admirable arrangement of the great Author of nature, who has rendered it necessary that these animals should be torpid during all the time that their appropriate food is not to be obtained. In warm climates, where a constant succession of insects occurs, the same species of bat which, in a cold region, would become torpid, continue in activity throughout the year.—Bats enjoy the senses of sight and hearing to a considerable degree of perfection, but the acuteness of their sense of touch is perhaps unequalled throughout the whole extent of animal organization. In consequence of the great expansion of integument forming the exceedingly delicate membrane of the wings, ears, and nasal appendages, bats are able, even when deprived of their eyes, to fly in such a manner as to avoid every obstacle. Silk threads, small sticks, or obstructions placed across the course of flight of a bat purposely blinded by taking out its eyes, are avoided with the most surprising dexterity, and advantage is taken of any space to pass between without touching them. Every inequality in the ceiling of a hall or chamber is avoided in the same way. The reaction of the air against the membranes is sufficient to warn them of any obstacle, however slight, and enables them to turn, lower themselves, or draw in their wings, so as to clear the body, without the least appearance of effort. These soft, velvet-like wings also enable them to fly without noise, and, although their motion is unsteady and wavering, they advance with exceeding swiftness. From a flat or level surface, it is very difficult, though not entirely impossible, for them to rise into the air. They always suspend themselves by the hooks on their hind feet, whence they readily take wing by relinquishing their hold. The hook at the extremity and anterior edge of the fore-arm corresponds in situation to the human thumb, and the bats use it with peculiar advantage in changing their position. Bats generally bring forth

two young, and suckle them until old enough to purvey for themselves. While suckling, they remain closely attached to the mother's teats, which are two, situated upon the chest. The parent shows a strong degree of attachment for her offspring, and, when they are captured, will follow them, and even submit to captivity herself, rather than forsake her charge.—The voice of the small bats, when irritated, is a sharp chattering sort of squeak. They bite with much force, and those of considerable age and size can inflict a very severe injury, as their teeth are pointed and keen. Although not many years ago, the number of bats known to occur in Britain amounted only to six, there are at present described in our more recent works on the Zoology of this country not fewer than sixteen species. The characters of these are briefly given in Jenyns' 'Manual of British Vertebrate Animals,' and more fully in Mr. Bell's beautiful work on the British Mammalia. Many of the species have been found only in the southern counties of England; and it is somewhat remarkable, that hitherto the species observed in Scotland do not exceed three at most. The common bat of the latter country is the *Pipistrelle*, *Vespertilio pipistrellus* of Gmelin and Desmarest, although, previous to Mr. Jenyns' researches, it was considered as the *V. murinus* of Linnæus, a much larger species, which has also been found in England. The *Pipistrelle* we have determined from species obtained in various parts of the south of Scotland. The only other species which we have hitherto met with, north of the Tweed, is the *Plecotus auritus*, the Long-eared bat, which in some places is nearly as plentiful as the *Pipistrelle*. Dr. Fleming, besides these, mentions the *V. emarginatus* as having been found in Fife; but it is probable that the information is not to be depended upon, especially as the characters which he gives are vague, and equally applicable to the *Pipistrelle*, and as he considers the *V. murinus*, which is the *Pipistrelle*, to be the common bat, although that has not been found in Scotland.

BATATAS. See BATTATAS.

BATHING. The cleansing or medicinal application of water or other liquids to animals. The cold bathing of a horse is accomplished by making him swim in a river. This remedy has been known to remove a case of obstinate costiveness; and, when repeated at certain intervals, has been found beneficial in cases of locked jaw. It has been recommended also, but without good reason, in cases of lameness arising from strains. The use of a warm bath, when it can be rendered practicable, seems to be serviceable in spasmodic complaints. The bathing of particular parts of the body with lotions or medicated waters, is, in very many and various cases, serviceable.

The bathing of sheep is the application of medicated liquid by rubbing, syringing, or dipping, for the purpose of destroying the ked or sheep-tick, and of preventing cutaneous eruptions. The ked is an insect which greatly annoys sheep

towards the autumn, and provokes them to rub and break their skin; and cutaneous eruptions of various kinds and degrees, even to the extent of scab, are very apt to be produced by a change of food from grass to turnips, or by any other equally great transition of habit. The principal ingredients—perhaps the only useful ones—in the bathing liquids which have been longest in use, are tobacco-water and the spirit of tar; a very good bathing liquid is made by mixing one pound of black soap and thirty-two pounds of tar with a sufficient quantity of water or soap-suds; and numerous bathing liquids have of late years been brought into notice, medicated with such dangerous and dreadfully active ingredients as arsenic and corrosive sublimate, or made up with quack mixtures of unknown composition, but, in one or two instances, of considerable celebrity. The old method of bathing is practised by pouring or syringing the animal on a bathing-stool; and the new method is practised by dipping him in a bathing-box, placing him upon a drainer, and letting him slide down a short inclined-plane into a pen. The bathing-stool is wide and sparred for the body of the animal, and has a close seat at its short end for the operator; and the bathing-box, the drainer, the inclined-plane, and the pen, unitedly constitute one apparatus, specially constructed for the process of bathing. The method by pouring is effected by the operator shedding the wool in lines, and an assistant applying the liquid along the shedding; and the method by syringing is effected by the operator introducing the point of the charged instrument among the roots of the wool, and pushing it forward in a direction parallel with the length of the body. A kindred operation to the bathing of sheep is smearing. See the articles SHEEP-SMEARING and WASHING.

BATTATAS, or SWEET-POTATO. A tuberous and esculent rooted, perennial plant, of the convolvulus family. It was formerly called by botanists *Convolvulus Batatas*; but is now called *Ipomœa Batatas*. It is a native of the tropics, and was introduced to Great Britain about the end of the 16th century. Its tubers were formerly imported, in considerable quantity, every year from Spain and Portugal, and sold in our markets under the name of Spanish potatoes; and they are the potatoes referred to in Shakspeare's *Merry Wives of Windsor*,—"Let the skye rain potatoes, and hail kissing-comfits." The tubers are sweet-tasted, nutritious, and productive, and are extensively cultivated and much esteemed for food in India, and in many other hot countries of the world. They are very palatable, when cooked in almost any ordinary manner; and they form a most delicious dish, when cut into slices raw, and fried with butter. The plant is cultivated in the same manner as the common potato, but requires much more room. Many trailing stems grow from one tuber, and extend in all directions, to the length of from four to six feet:

and at their joints, they strike root, and form large tubers; so that from one tuber, no fewer than 40 or 50 large tubers are produced. A few plants are raised as curiosities in the hothouses of Great Britain; and some unsuccessful attempts have been made to bring them to maturity in the open ground.

BATTEN. A scantling of wood, one inch thick, and from 2 to 4 inches broad.

BATTS. The flatulent colic in horses. See COLIC.

BAVINS. Faggots or bundles of brushwood for fuel, made with full-length brushwood.

BAVIN-TUG. A waggon used in many of the woodland districts of England for transporting bavins from the wood or coppice to the farmery. It carries, at one load, 150 bavins, each 4 feet in length and 3 feet in girth. It consists of a long, low frame, mounted on two axles, 14 feet apart; and it can be used, without much risk of upsetting, on even the narrow and almost impassable cross country roads of the weald of Kent, and neighbouring districts.

BAY. An indentation of the sea or of a large lake upon the land; also, the part of a thrashing barn which is occupied by a mow; also, an evergreen tree of the laurel genus; also, a colour, inclining to chestnut, and taking its name from a dried bay-leaf; also, by a figure of speech, a bay-coloured horse. See the articles BARN, BAY-HORSE, and BAY-TREE.

BAY-HORSE. A horse whose entire or prevailing colour is bay. The dark-tinted bay colour approaches nearly to brown, but is more gay and shining. The bright bay-horse is exceedingly beautiful; for he generally has a reddish tint, with a gilded appearance, while his mane and his tail are black, and his back is streaked along the spine with a black or dark list. Many horses of medium-coloured bay have also black manes and tails, and the dark list along their back. Most dark bay-horses have their knees and pasterns black; and several kinds of bays have the whole of their limbs black, from their knees or their thighs to their feet. Most bays which want the list along their back, have a black colour over their reins; and this goes off by an imperceptible gradation to a light colour toward their belly and flank. Some of these bays incline to brown, and are more or less dappled. Horses of all the different shades of bay present a pleasing appearance to the eye; and, unless they were spoiled by some accident when they were colts, they are generally well-formed and healthy.

BAY-SALT. Common culinary salt, obtained by the evaporation of sea water or other saline water, in the open air, without the application of artificial heat. The crystals of it, in consequence of the slowness of the evaporation, have sufficient time to shoot, are much larger than those of artificially evaporated salt, and have the form of regular cubes, while those of the latter are hollow four-sided pyramids. A cheap and easy

mode of obtaining it is afforded in natural hollows of the shore, overflowed only by spring-tides, in countries which enjoy much sunshine, and have long continued droughts. Bay-salt contains a smaller admixture of foreign materials, or a larger proportion of chloride of sodium, than any other kind of culinary salt, except rock salt; and it is the best suited for the salting of both butter and provisions. Bay-salt from St. Ubes in Portugal, commonly called St. Ubes salt, and long held in high esteem by the provision-curers of Great Britain, contains 96 per cent. of chloride of sodium, 2·8 of sulphates of lime and magnesia, ·3 of chloride of magnesia, and ·9 of insoluble matter. The principal places at which bay-salt is obtained are St. Ubes and Setubal in Portugal, the coasts of Brittany, Saintonge, and Pays D'Aunis in France, Porto Ferrajo in Italy, Trapani in Sicily, various other parts of the coasts of the Mediterranean, and in the island of Tortuga, near the coast of Terra Firma, in America. See the article SALT.

BAY-TREE,—botanically *Laurus nobilis*. A hardy, ornamental, evergreen, small tree, of the laurel tribe. It is regarded by many writers as the true laurel, with which the ancient Romans crowned their successful generals; it is regarded by many scientific men as the type of the large and beautiful genera *Laurus* and *Cinnamomum*, and indeed of the whole order *Laurinæ*; and, in spite of the existence of both in almost every shrubbery or even villa-plot in Great Britain, it seems to be often confounded by loose observers with the cherry laurel. See article LAUREL. Either the true bay-tree, or some one of its congeners, appears to have been introduced to Great Britain by the Romans; but it probably was allowed to die out; and it was re-introduced from Italy about the middle of the 16th century. Turner, who wrote in 1564, says, "The bay-tree in England is no great tree; but it thriveth there many parts better and is lustier than in Germany." But so late as the second decad of the 18th century, it seems to have retained some tenderness of habit, for Bradley says in 1716, "The bay-trees should be put in pots or cases, and housed in the winter, that their beauty may be preserved."

The bay-tree grows usually to the height of about 15 feet, and occasionally to the height of 20 or 25; but it most commonly occurs in the form and size of a bushy shrub of from 4 to 12 feet in height. Its bark is smooth, greenish, and aromatic; its leaves are lanceolate, smooth, and leathery on both sides, about three inches long, and two inches broad, hard, rigid, and of a deep green colour, yet neither so rigid nor so leathery as those of the cherry laurel; its flowers are glandular, dotted, and yellowish-white, are produced in clusters of four or six, and bloom in April and May; and its fruit is black, oval, fleshy, and about the size of a large pea. It thrives best in deep, rich, old garden soil, and prefers shade to sunshine; yet it prospers in our hottest sands and gravels; and, after having surmounted the

hardships of transplanting, it very rapidly acquires both height and breadth. It thrives under the shade and drip of larger trees, in situations where few other ornamental shrubs will grow, and therefore is eminently adapted for the foregrounds of ornamental plantations. But in exposed districts, it requires protection from north and north-east winds, in order to its either attaining a good size or possessing tolerable beauty.—The principal varieties of the common bay are the wave-leaved, *Laurus nobilis undulata*, growing to the height of about 4 feet; the willow-leaved, *L. n. salicifolia*, about 6 feet high; the variegated leaved, *L. n. variegata*, about 20 feet high; the curled-leaved, *L. n. crispa*, about 20 feet high; the double-flowered, *L. n. flore pleno*, about 20 feet high; and the broad-leaved, *L. n. latifolia*, a half-tender variety from China.

The bay-tree may be propagated from either layers, cuttings, or berries. Stools ought to be specially planted for layers; and in winter, after these have shot about a yard, the branches ought to be bent to the ground, slit in the joint, stripped of any leaves which occur toward their top, and pegged down into the soil. The layers will be fully rooted in a twelvemonth; and the young plants ought to be detached in spring, planted out in a nursery bed, and constantly watered during the continuance of dry weather. Cuttings should be taken off in April, planted in a moderate hot-bed, kept constantly moist by waterings, and sheltered from the sun in summer, and from frost in winter.—Berries intended for sowing, ought not to be gathered from the tree till about the end of January; and must be sown, either broadcast or in drills, about half an inch deep, in fine smooth mould. The young plants will appear toward the end of spring; they must be duly watered and weeded during summer; and they ought, early in winter, to be protected by rows of furze bushes or branches stuck in between the drills. In the second spring, or after they have stood during two winters, the strongest may be transplanted into nursery beds.

The leaves and the berries of the bay-tree have a sweet fragrant odour, and an aromatic, astringent taste. They have carminative and narcotic properties; they were formerly used in human pharmacy for coughs, hysteria, flatulent colic, and obstructed menstruation; and they are still employed, in combination with other stimulants, as an external application for various complaints. A very minute proportion of prussic acid occurs in water distilled from the berries and the leaves; and this most potent element not only gives the leaves their chief medicinal power, but also renders them observably poisonous. Dr. A. T. Thomson says,—“Having found great advantage from the use of prussic acid, largely diluted, as a local application in impetigo, I have lately employed infusions of bay-berries, with nearly the same beneficial results.” An oil which is obtained by boiling the berries in water, possesses the same medicinal

properties as the berries themselves, and is imported from the Straits. The simple expressed oil is insipid. Bay leaves are used in farriery only as an ingredient in fomentations. The leaves wrapped round the wedges of liquorice juice in commerce, to prevent them from adhering to one another, are dried bay-leaves.

The Indian bay, Royal bay, or Portugal bay, *Laurus Indica*, grows wild in the Madeira and Canary Islands; and it was introduced thence at an early period into Portugal, and in 1665 into Great Britain. It has for centuries been so plentiful in Portugal, as to appear there like a native plant. In a genial climate it grows to the height of 30 or 40 feet; but in England, it requires to be grown in tubs or large pots, and to be treated as strictly a greenhouse plant. Its leaves are larger than those of the common bay, thick, smooth, lightish green, and standing on reddish footstalks; its branches are regularly disposed on every side; its male flowers have a whitish green colour, and are produced in long bunches; and its berries are much larger than those of the common bay.

The Carolina bay, *Laurus Carolinensis*, abounds in various parts of North America, but especially in Carolina, and is there called the red bay. In some situations near the sea, it rises to a considerable height with a straight stem, and is a somewhat important timber tree; but in inland districts, it grows to be only a large shrub. Its timber has a fine grain, and is in much esteem for cabinets. Its leaves are much larger than those of the common bay; their under side is a little woolly; their edges are a little reflexed; and their veins run transversely from the midrib to the edges. The male flowers have a yellowish green colour, and come out in long bunches from the wings of the leaves; and the female flowers are produced in loose bunches, and stand on red and rather long footstalks. The berries are blue, and sit in red cups. This species is a greenhouse plant in Great Britain. Two principal varieties of it are the obtuse and the pubescent,—*obtus* and *pubescens*.

The summer bay, *Laurus aestivalis*, is a native of swampy places, and of the sides of brooks and rivers in Virginia. It is a tall deciduous shrub, and is sometimes called the deciduous bay; though six other species of the same genus are also deciduous. In a rich moist soil, it grows to the height of about 16 feet; but in some soils of a different character, it attains scarcely one-half of that height. Its branches are smooth, purplish, and not numerous, and they look well during even their leafless season; its leaves are oval, spear-shaped, about two or three inches in length, smooth and green in their upper surface, rough and veined in their under surface, and placed in mutually opposite pairs along the branches; and the flowers are small, white, inconspicuous, and are produced from the sides of the branches in May.

The principal other species of the bay or laurus are the geniculated, the whitish-leaved, Jove's fruit, and Catesby's, hardy, ornamental, deciduous shrubs; the Benjamin tree and the Sassafras-tree, hardy, medicinal, deciduous trees; and the snow-white, the spreading, the strong-smelling, the pendulous, the aggregate, the shining, the leather-leaved, the bundle-flowered, and the thyrses-flowered bays, tender, ornamental, evergreen trees and shrubs; and the Cogwood tree, a lofty, evergreen, timber-tree of the West Indies. But upwards of a dozen species, including the cinnamon, cassia, and camphor trees, which were formerly included in the laurel genus, are now assigned to the genus *Cinnamomum*.—*Miller's Dictionary*.—*Loudon's Hortus Britannicus*.—*Marshall on Planting*.—*Thomson's Dispensatory*.—*White's Veterinary*.—*Anderson's Commercial Dictionary*.

BEAD-TREE,—botanically *Melia*. A genus of ornamental trees, forming the type of the order *Meliaceæ*. The plants of this order constitute fourteen genera; all are trees or shrubs; most are natives of the tropics; most have pinnated leaves; and all are distinguished by an union of the stamens into a tube bearing the anthers. Nine or ten species of the bead-tree genus have been introduced to Great Britain, principally from the East Indies; and, excepting the azedarach, all these are ornamental evergreens.

The azedarach, *Melia azedarach*, is a native of various districts of the East, from the Mediterranean to the Ganges, and was brought to Great Britain from Syria, about the middle of the 17th century. It is a deciduous tree, serviceable for both its beauty and its timber; and attains a height of about 50 feet. Its trunk is covered with a grey bark; its young branches are green, smooth, and not numerous; its leaves are compoundedly pinnate, very large, and exceedingly elegant; its flowers are bluish, fragrant, beautiful, resembling those of our common lilac, and are produced in long clusters, in the month of July, from the sides of the branches; and its fruit is oblong, about the size of a small cherry, green when growing, pale yellow when ripe, and consisting of an exterior pulp, and an interior nut or kernel. Each leaf is from 18 inches to two feet in length, and consists of very many leaflets, arranged into three wings; and each leaflet has its upper surface of a strong shining green, its under surface paler, and its edges indented. Each flower belonging to a cluster is separately small, and stands on a comparatively long footstalk. The pulp of the fruit is poisonous, and, if mixed with grease and given to dogs, will kill them. The nut or kernel of the fruit has five deep furrows, and comprises four or five cells, each containing a seed; and, in Roman Catholic countries, it is collected in quantities, bored through, and strung into rosaries; and from this use of it arose the name of bead-tree. The azedarach is usually regarded as a green-

house plant in England; yet it has flourished exceedingly well, and resisted the frosts of many winters, against warm walls, or even in well-sheltered spots of open ground; and Hanbury even says, "I have planted it in an open cold expanse, in a naturally damp and moist soil, where it has flourished for more than seven years, and displayed its foliage every summer, to the great pleasure of all beholders." This tree is highly ornamental, enjoys great repute in many Roman Catholic countries, and well deserves attention as a magnificent embellishing plant, in sheltered spots of the southern or central counties of England. It is propagated from cuttings in sandy loam, or from seeds in pots, plunged into a hot-bed. It is usually called in Italy *Pseudocycamorus*, and in Spain and Portugal *Zizyphus alba*.

The azadirachta, or evergreen and always-flowering bead-tree, *Melia azadirachta*, is a native of the East Indies, and was introduced to Great Britain about the middle of the 18th century. It grows to the height of 60 feet, and is appreciated in India for at once its beauty, its timber, and its economical uses. Its stem is thick, its timber is of a pale yellow colour, and its bark has a dark purple colour, and a very bitter taste. Its branches extend far on every side; its leaves are pinnate, each wing consisting of five or six pairs of leaflets and a terminal one, and each leaflet oblong, acutely pointed, serrated, lightish green, strongly and very disagreeably flavoured, and standing on pretty long footstalks; its flowers are small and white, and are produced in long ramose panicles from the sides of the branches; and the fruit is oval, about the size of a small olive, successively green, yellow, and purple,—the pulp oily, acrid, and bitter, and the nut white and shaped like that of the azedarach. The tree grows in sandy land both in Ceylon and in Hindostan, and produces flowers and fruit twice a year. The bark is regarded by the Hindoo physicians as one of their most valuable tonics, and is usually exhibited in powder or in decoction, along with some aromatic, in cases of fever, of chronic rheumatism, and of almost every disease for which British practitioners employ cinchona. A fixed bitter oil, which is expressed from the ripe fruit, is esteemed an excellent remedy against intestinal worms, a good external application in cases of foul ulcer, an effective liniment for rheumatisms, spasmodic affections, and certain kinds of violent headache, and a valuable preventative of catarrh or fever from exposure to cold or damp. A particular sort of toddy is prepared from the sap of healthy young azadirachtas, and is sometimes prescribed by the Vytians as a stomachic. The timber is both very compact and very durable, and is used for making bandy wheels, and for many other purposes. The leaves and the small branches are used in the worship of one of the Hindoo idols.

Another evergreen bead-tree,—evergreen by specific name as well as by nature, *Melia semper-*

virens,—is a native of Jamaica, grows there to the height of about 40 feet, and was introduced to Great Britain about the middle of the 17th century.—A beautiful species, called the compound-leaved, *Melia composita*, is a native of Teneriffe, grows to the height of 20 feet, and was introduced to Britain in 1810.—A recently discovered and half-hardy species, called the Australian, was introduced a few years ago from New Holland.—All the other introduced species are evergreen natives of India; and one of them bears the name of the Guinea Lilac.—*Miller*.—*Loudon*.—*Marshall*.—*The Materia Medica of Hindostan*.

BEAM. A piece of wood, or of iron, used in supporting a weight, or resisting a pressure. The general results of the strength of wood are given in our article **STRENGTH OF MATERIALS**. From existing structures, it appears that security will be attained by limiting the weight borne by a timber beam to one-fifth of that which would cause rupture by compression. Although the elasticity of timber is said not to be affected by a force which is between one-fourth and one-third of that which causes rupture, still it is prudent not to submit it to so great a permanent strain.

To determine the limits of the cross strain to which timber can be submitted with safety, it should be borne in mind, that the degree of flexure caused by the strain must not impair the elasticity of the fibres, so that when the strain is taken off the piece may regain its natural form. There are no special experiments from which this limit can be ascertained; but, from an examination of existing structures, it seems that timber may be exposed with entire safety to a cross strain equal to one-tenth of that which would cause rupture.

When a vertical beam is pressed by a force at top, it has been ascertained by experiments, that if the length is greater than 8 or 10 times the thickness, rupture will take place by the bending of the beam; and that when the length is less than 8 times the thickness, the beam will yield by crushing. In all cases where the length is less than 20 times the thickness, the weight to be borne will be estimated from that by which rupture is caused by crushing the fibres. But as any slight lateral strain in addition to this would cause the beam to give way, this weight must be farther reduced, depending on the length of the beam. The experiments made to ascertain this reduction, indicate that, for wood, the weight borne should be reduced to the four-fifths, when the length is equal to 12 times the thickness; and to one-half when it is 24 times the thickness. For cast-iron, the weight should be reduced to the two-thirds, when the length is 4 times the thickness; to about the one-half, when it is 8 times the thickness; and to the one-fifteenth, when it is 36 times the thickness. For forged iron, the weight should be reduced to the five-eighths, when the weight is 12 times the thickness; and to one-half, when it is 24 times the thickness.

The following are the medium crushing weights for a square inch of each of these materials, when the length is once or twice the thickness.

Oak and Pine	4,000 lbs.
Forged iron	60,000 —
Cast-iron	140,000 —

Having ascertained the reduction of the crushing weight required by the length, the total permanent weight borne should be only about one-tenth of this for wood, and between one-fourth and one-fifth for forged or for cast-iron. "The rule that is generally followed by practical men," says Millington, "for determining the necessary strength and dimensions of a pillar or vertical support, is to take such of the experiments as have been before detailed as may suit the case, and to multiply the result given until it reaches the sought-for power, and then to take only one-fourth or one-fifth of that quantity to work upon. Thus, if a single square inch of brick is capable of supporting 562 lbs., two inches should support twice that weight, or 1,124 lbs., and ten inches should support 5,620 lbs., and so on; but instead of trusting the ten inches of brick to bear the 5,620 lbs., only one-fourth or one-fifth of that load should be placed upon it; or if the whole load must be carried, the surface of brickwork should be extended to four or five times ten inches. This has always been deemed a safe rule, because it is merely making the strength to increase as the area, and then only using about a quarter of the strength given by the trial. The reason for making so large a deduction is twofold; first, to guard against imperfect workmanship, and, secondly, against natural decay. By imperfect workmanship is meant the almost impossibility, in practice, of getting heavy beams or pieces of stone to bear equally upon every part of the surface that is prepared to support them, arising from the difficulty in moving and placing heavy bodies, or from the support settling or sinking to a greater distance than was contemplated, in consequence of receiving the new load, or its settling unequally in different parts. Thus a pier of brickwork containing 180 square inches of surface, might be built to support a burden of many thousand pounds, which it would be fully competent to bear, provided the weight was equally distributed over the whole surface. But in placing it, it might happen that the whole would rest upon three or four square inches, which, being incompetent to the load, would fail, and transfer it to another small part, equally incompetent to bear it, and thus the whole might fail."

BEAN,—botanically *Faba*. A well-known cultivated plant, of the vetch division of the leguminous family. It is cultivated in both the garden and the field, for the sake of its large, nutritious, dicotyledonous seeds; and is so universally known to our population, both urban and rural, as not to require any description. Its flowers are of the butterfly kind, large, beautiful, and grate-

fully odoriferous; its pods are of very uncommon size, one-celled, and provided with a deep, downy packing for the seeds; and its cotyledons, compared with those of the great multitude of exogenous plants, are gigantic, remarkably well defined, and admirably adapted to display the wonders of embryo vegetable development. Even if the bean were not a plant of great economical value to the farmer and the gardener, it could not fail to possess a fascinating interest for at once the archæologist, the florist, the phytologist, and the vegetable chemist.

History of the Bean.—The bean figures in very ancient notices of agriculture, and was more esteemed than any other kind of pulse by both the ancient Greeks and the early Romans. The Athenians used sodden beans in their religious festivals in honour of Apollo; and the Romans presented beans in a festival which they held in honour of Carna, the wife of Janus, and to which, in allusion to the beans, they gave the name of Fabaria. Janus, whom the Romans always represented with two faces, was a personification of Noah, looking backward to the world which had been destroyed, and forward to the world which his offspring were to replenish. Carneus was another name given to Noah by his descendants; and hence the name Carna was used to designate his wife,—the wife of Janus; and the bean was presented on her festival, as well as on many other occasions, on account of the resemblance of the shape of its pod to the form which tradition assigned to Noah's ark. In Egypt also, the ship of Isis was a type of the ark, as Osiris was a personification of Noah; and in every anciently inhabited country, some of the earliest traditions or most venerated legends make reference, more or less direct, to the awful events of the deluge, and, in most instances, embody some type or illustration of Noah's wonderful deliverance. On this account, the bean, from the supposed ark-like shape of its pod, seems to have been generally adopted among the more civilized polytheists of antiquity as a sacred type of the Noahic deliverance, and as an important element in the symbols of idolatrous worship. The bean appears to have been regarded in Egypt as typical of some of those mysteries which the priests constantly endeavoured to conceal from the knowledge of the uninitiated, and therefore was publicly shunned by the priests as an object too sacred for ordinary observation. Pythagoras, who travelled into Egypt in search of knowledge, and who obtained there a large portion of his philosophy, seems to have adopted the Egyptian priests' notion of the bean; for, during the period of his influence in Greece, he forbade this legume to be used. The bean is held sacred by the modern Hindoos, and is mentioned in some of their wildest and most ancient legends.

The noble and powerful family of the Fabii among the ancient Romans are supposed by some writers to have taken their name from special

connexion of their ancestry with the cultivation of the bean. A dish or meal of beans was called in Latin *lomentum*, and was eaten with whole corn in a gruel or pottage. Beans were used by the Romans, in taking the votes of the people, and in the election of magistrates. They were likewise used for medicine; and when bruised and boiled with garlic, were regarded as a cure for old and stubborn coughs which had baffled every other remedy. The meal or flower of beans was thought to possess the power of removing wrinkles and smoothing the skin, and was in consequence used by the Roman ladies as a favourite cosmetic.

The bean is said by some travellers to be growing wild in Persia, near the shores of the Caspian sea; and it either may be indigenous there, or may have been brought thither by some of the numerous tribes and armies which, in ancient times, rushed across Persia in careers of conquest. The bean is indigenous in Egypt, Barbary, and Morocco; it is believed to have been originally introduced from the first of these countries into Great Britain; it was transplanted by the Moors from Barbary into Spain, and by the Portuguese from Spain into Portugal; and the Mazagan variety, which has long been regarded in Britain as the best for an early crop, was obtained from a Portuguese settlement on the coast of Morocco, called Mazagan.

Roman cultivation of the Bean.—The *faba* of the Roman writers on rural affairs, though treated by them as the most important of their leguminous plants, has been pronounced by learned commentators a plant different from the present *faba* of botanists, and possessing characteristics which are not found united in any existing legume. But so very useful, prominent, and widely diffused a plant as the Roman *faba* can scarcely by any possibility have become lost; most of the recorded characteristics agree quite closely with those of our common small field bean; one or two circumstances, rather than characteristics, are discordant or inexplicable, principally from obscurity or ambiguity in the language which states them; and, at the very utmost, the Roman *faba* may have been a variety of bean, which is now slightly obsoleted by changes in climate and culture, and by the influences of hybridizing and improvement.

Pliny says that the *faba* does not come up till from 15 to 20 days after it is sown; that it is longer in coming up than grain or any other kind of pulse; that it comes up in a leaf, and then puts forth the stem; that its stem is single, and is not divided by knots; that its leaves are round and numerous; that a crop of it flowers during so long a period as forty days; that, though no one stem flowers so long, yet when one stem is passing out of flower, another is but beginning to bloom; that the seed is perfected in forty days after the flowering; that the pods are produced alternately on each

side of the stem; that the straw of the autumnal sowing is better than the whole crop of the spring sowing; that the pods are long, and of a breadth corresponding to the shape of the seed; that both the pods and the stems are good fodder for cattle; that the faba is the most useful of the legumes; and that, if a proper order is observed, the turnip ought to be mentioned next to corn, or at least next to the faba. Throphrastus notices some of the same characteristics of the faba, and adds that it puts forth many leaves on all sides, carries pods very near to the soil, and is the only one of the legumes which has a perfectly erect stem. Cato mentions the faba among the crops which improve land, and directs it to be sown on a strong soil. Varro says that the time of sowing it is about the end of October, and that four modii of seed were required for a jugerum of land. Virgil directs the corn-seed of the faba to be steeped in an infusion of nitre and amurca, in order that the crop-seed might grow large in the pod. Columella says, "Land very rich naturally, or well dunged, is set apart for the faba; and if this land has rested a year, and is situated in a valley, which receives sap from higher grounds, the seed should be sown on the firm soil, then ploughed in, ridged, and harrowed, that so the seed may be covered the deeper; but if the land has carried a crop immediately before, let the straw be cut down, and twenty-four loads of dung spread on the jugerum; after this, it may be treated like the land that has carried no crop the preceding year." Palladius says, "The Greeks assert that the faba seed which is steeped in capon's blood is not hurt by destructive weeds; that, if infused in water the day before sowing, it will spring the sooner; and that, if sprinkled with water which has nitre dissolved in it, it is more easily boiled."

Varieties of the Bean.—The bean was formerly treated as a species of vetch, under the name of *Vicia faba*; but it is now regarded as constituting a genus of itself, under the name of *Faba*. Two principal subspecies of it are easily distinguishable from each other; the one called botanically *Faba vulgaris arvensis*, *Faba vulgaris minor*, or *Faba vulgaris aquina*, and popularly field bean, small bean, horse bean, or grey bean; and the other called botanically *Faba vulgaris hortensis*, or *Faba vulgaris major*, and popularly garden bean, large bean, or white bean. But several well-established varieties are included in each; three well-established varieties may be included under either; and therefore all the kinds of beans in cultivation may be arranged into three classes,—field beans, garden beans, and field or garden beans.

The Scotch bean or common horse bean is almost the only variety of field bean cultivated in Scotland; and though not so prolific as the tick beans cultivated in England, recommends itself by its superior height of stem, and especially by its greater hardiness. Its seed is from half an

inch to five-eighths of an inch in length, and three-eighths of an inch in breadth; irregularly compressed and wrinkled on the sides, and often a little flattened or hollowed at the end; of a light brownish colour, occasionally clouded and dappled with a darker colour, especially toward the end, and always black in the eye. Its stem measures from three to five feet in height; and the average weight of its seed is 62 pounds per bushel. Yet the Scotch bean is far from possessing uniformity of characteristics and appearance; and must be considered, much less as one defined variety, than as a very variable mixture of several varieties. The fact of such a mixture is readily and abundantly apparent in the vast and beautiful diversity of colours in the flowers of any Scottish bean-field, and may even be frequently detected at a glance in the diversified tints and minor characteristics of the seeds. In common with all varieties of beans, however, the Scotch bean is much affected in both shape and colour by peculiarities or changes of climate, soil, and culture; and hence it is always plumper and whiter in a warm dry year than in a cold and damp one, when raised on a strong rich clay than when raised on any kind of light soil, and when cultivated in drills than when sown broadcast.

The tick beans, cultivated in the fields in England, are more prolific in pods and much more suited to light soils than the Scotch or common horse bean, and therefore have, for a very long period, been preferred to that bean by the great majority of English farmers. Yet the common tick, or variety of tick most extensively in use and highest in favour, is often called in England common horse bean or common field bean. Its seeds are smaller and more cylindrical than those of the Scotch bean, and are rounded at the ends. The weight of its seeds per bushel is about 67 pounds.—The Harrow tick bean is smaller in all its parts, and better adapted for light soils than the common tick; and its seeds are remarkably plump and hardy.—Other subvarieties of tick bean are the flat tick, the Essex tick, the French tick, the May bean, and several more; but they differ from the common tick only in being cultivated on different soils, or under different circumstances.

The winter bean, called in France *La fêverolle d'hiver*, grows to the height of three or four feet, and is both very hardy and very prolific. Its seed is small, very plump, very heavy, smooth, and full in the sides, very black in the eye, and of the same colour as the Scotch bean, but with the addition of a dark greenish spot on the short side. This variety was introduced to England about the year 1825, and stands well the severest winters both there and in France.—The Heligoland bean is very closely allied to the winter bean, and has even been pronounced identical.

The pigeon is the smallest of all the field beans, and has its name from being used instead

of pease for feeding pigeons. It is early, prolific, and of dwarfish growth; and its seed is considerably darker in colour than either the Scotch or the tick beans. It originated in Germany, and is extensively cultivated there on the lighter bean soils; but it has as yet found little favour in Great Britain.—The purple field bean has also been little tried in this country, yet might probably succeed as a winter bean, and certainly deserves attention. Its flower has a pinkish tinge, and is otherwise redder and darker than that of the common winter bean; its seeds have a reddish-brown or purple colour; and it is later in ripening than the pigeon bean, and not so prolific.—The Alexandrian field bean grows to about the same height as the Scotch bean, but is later in ripening; and its seeds resemble those of that bean in shape and size, but are not so plump, and have a dull reddish-brown colour.—The new large red or scarlet field bean was discovered in a field of Scotch beans, in the Carse of Gowrie, in 1834: and is a very prolific and remarkably distinct variety, with large reddish-coloured seeds.—The Swiss bean is a lately acquired variety of winter bean; it stands the frosts of England without injury; it may be sown from the middle of September till the middle of October; it pods about the first of June, ripens in the latter end of July, and escapes the attacks of insects and mildew; and it appears to be peculiarly suited to the warmer districts of England.—Two other varieties of field beans are the Ainfield and MacPhail's.

The Mazagan and the long-podded beans have a medium habit and a medium size of seed between the field beans and the garden beans; and are suitable alike for garden culture and for the better kinds of field culture.—The Mazagan bean, as already noticed, is a native of the quondam Portuguese settlement of Mazagan, on the coast of Morocco, immediately west of the Straits of Gibraltar. Its seeds, as grown in its native place, are said to be smaller than even those of the Scotch bean; but they grow to a larger size in Portugal and in England. "If the seeds are saved two years in England," remarks Miller, "the beans will become much larger, and not ripen so soon, which is called a degeneracy." The stem of the Mazagan bean is about four feet high, and rather slender; its pod is narrow, and from four to five inches long, and contains four or five seeds; its flower is white, with dark brownish stripes on the standard, and two dark brown spots on the wings; and its seed is of a whitish colour, and both large and more flattened than that of the horse bean. This variety loves soil of medium quality, as near as possible to normal loam, and dislikes both strong clays and very light soils. Miller complains that, in his time, in consequence of the slovenly gardening of the Portuguese, a large proportion of the seeds imported from Portugal were bad. The Mazagan bean has as yet been seldom tried in

the field in Scotland; though, from its early and prolific habits, it would almost certainly succeed in any favourable situation.—The Portugal bean is simply the Mazagan bean a little modified, and somewhat deteriorated by cultivation in Portugal; and is now seldom mentioned as a distinct variety.—The small Spanish bean is another modification of the Mazagan, sweeter in taste, and a little later in habit, than the Portugal.

The long-podded bean is somewhat more prolific than the Mazagan, and generally about a week later. Its stem grows to the height of from four to five feet; its pod measures from six to seven inches in length, and about one inch and a quarter in breadth, is rather pendulous, and contains four or five seeds; and its seed measures about an inch in length and five-eighths of an inch in breadth, and is flat, rounded at the end, and of a whitish colour when ripe. The subvarieties of this bean are very numerous, and are constantly changing; for any one kind is much modified by two or three years' culture under widely different circumstances from those to which it has been accustomed, and almost any two kinds become assimilated to each other after two or three years' culture in the same farm or garden. Yet many of the subvarieties have distinctive names; and several possess considerable pretensions to distinctiveness and permanence of character. Among the best known are the Sandwich, the Lisbon, the early Lisbon, Child's new early long pod, the old early long pod, the Hangdown long pod, the large long pod, and the early mom. The Sandwich was known and esteemed in the days of Miller, and was cultivated as the next in succession in the garden to the Spanish. Child's new early long pod was recently introduced by the seedsman whose name it bears; it is rather earlier and more prolific than the common long pod; and its seed is thicker and less symmetrical in shape. But three varieties of long pod, the green, the Dutch, and the white-blossomed, are quite unsuited to field culture, and rank wholly as garden beans.

The white Windsor bean has long been regarded as the best variety for the table; and it is everywhere in great request for garden cultivation. It is the earliest of the late garden beans; it is also a sure bearer; and, as it does not ripen regularly, it affords a prolonged daily succession. Its stem grows to the height of four feet; its pod is short and broad, and contains two or three seeds; and its seed is flat, circular, about an inch in diameter, and whitish in colour, but varies in size according to season, soil, and culture. The principal subvarieties of the white Windsor, are the broad Windsor and Taylor's Windsor. But three other named and well-known subvarieties of white garden bean, the Mumford, the Broad Spanish, and the Turkey, are so nearly allied to the white Windsor as to be readily confounded with it in regard to both character and habit. The broad Spanish was known, highly esteemed,

and frequently cultivated in the time of Miller ; and was viewed as a good bearer, and treated for succession between the latest of the Mazagans and the earliest of the late broad white beans.

The green Windsor bean closely resembles the white Windsor in size, form, and habit. But its seeds are of a green colour when ripe, and may therefore be used at table in a more advanced state of maturity than those of the white Windsor. It is very nearly contemporaneous with the white Windsor, or at least does not lag behind more than a few days.—The red or scarlet Windsor, also called the dark red bean, is a prolific late bean, of good quality ; but is disliked by many persons on account of the colour of its seeds. Its stem grows to the height of four feet ; its pod is narrower than that of the white Windsor, yet contains the same number of seeds ; and its seed is similar in shape and size to that of the white Windsor, but is of a darker colour when young, and changes to a bright scarlet when of full size, and to a deep red when quite ripe.

The cluster or dwarf fan bean is a long known, an esteemed, and a prolific plant, and ranks as both the earliest and the most dwarfish of all the garden beans. Its stem grows to the height of two and a-half feet ; its pod is short and nearly cylindrical, and contains three or four seeds ; and its seed is larger and rather more flattened than that of the common Mazagan.—The Dutch long podded bean is very prolific, rather late, and not very well known. Its stem grows to the height of four or five feet ; its pod is long, broad, and slightly pendulous, and contains five or six seeds ; and its seed is about the size of that of the white Windsor bean, but more elongated.—The green long pod, also called the green nonpareil, and the green Genoa, is a prolific plant, and of good quality. It differs from the common long pod in being of much later habit, and in its seeds being green when ripe.

The Toker bean is very prolific, and of medium habit between early and late ; it was well known and much cultivated in the time of Miller ; but it is now considered rather coarse, and is therefore less in favour than the white Windsor. Its stem grows to the height of five feet ; its pod is long and very broad, and contains three or four seeds ; and its seed is of a whitish colour, and an elongated oval shape.—Johnson's wonderful bean has been quite recently introduced, and appears to be very good and prolific. Its pod is long, and contains six or eight seeds ; and its seed resembles that of the white Windsor in both size and shape.—The white blossomed bean, called also the white blossomed long pod, has the whitest flowers and the blackest seeds of all the known varieties of beans. Its stem grows to the height of nearly four feet ; its flower is pure white, and has not any dark spot on the wings ; its pod is long, nearly cylindrical, and slightly pendulous, and contains four or five seeds ; and its seed is about three-quarters of an inch in length, and

half an inch in breadth, rather thick or plump, and of a black colour, mixed with dark brown. It is at a glance distinguishable from every other variety by the colour of its flower. It is tolerably prolific, of medium habit between early and late, and is free in a great degree from the peculiar harsh flavour which characterizes every other variety of bean ; yet its seeds, when approaching maturity, are disliked by many persons on account of their extremely dark colour. This variety is very liable to degenerate ; and must not be judged, or propagated, from deteriorated seeds.

The violette bean is a rather early variety, and arrives at maturity about the same time as the common long pod. Its stem grows to the height of about four and a half feet ; its pod is long and broad, and contains three or four seeds ; and its seed has a size and shape intermediate between that of the long pod and that of the white Windsor, and is of a very light purple colour when young, and of a dark red colour when quite ripe.—The red or scarlet blossomed bean is most beautiful in flower, and very prolific in seed ; yet is disliked by the fastidious on account of its colour. Its stem grows to the height of four feet ; its flower varies in colour from a pale red to a reddish-tinted black, but is generally a bright red approaching to scarlet ; its pod is middle-sized, and contains four or five seeds ; and its seed has a darkish rusty brown colour, and resembles that of the long pod in shape, but is somewhat longer.—A black-blossomed bean mentioned by Miller seems either to be lost or to have become mixed and identified with the red-blossomed.

Farmers ought to be guided in the choice of varieties of the field bean, by reference to the peculiar circumstances of cultivation, and especially to the particular nature of the soil. Some varieties, as we have seen, are suitable only for heavy soils, and others are adapted in various degrees to lighter soils ; and any variety ought to be selected in preference to others, not from blind regard to the fashion of a district, but from an intelligent recognition of its fitness for the conditions of its intended cultivation. The prevailing and almost invariable use of the Scotch bean in Scotland, is altogether unworthy of the enlightened husbandry of the Scottish lowlands ; and the general use of the tick bean in England, to the prejudiced exclusion of the Scotch bean from at least stiff soils, is grossly inconsistent with the liberality and enterprise of the best English farming districts. Arthur Young, even in reference to the light-soil counties for which the tick bean is most suitable, said, "The common little horse bean has the advantage of all others, in being more generally marketable ; for in certain situations, it is not always easy to dispose of ticks, Windsors, long-pods, and various other sorts. They also grow higher, shade the ground in summer more from the sun, and yield

a larger quantity of straw, which makes excellent manure. But some of the other sorts are generally supposed to yield larger products. This, however, is a point on which some well-conducted comparative experiments are wanting."

Bean-seeds retain their vitality very long after they become so dry as to be shrivelled and hard; yet when long kept, they do not germinate so soon as when comparatively fresh. In judging of their age and their other qualities, one or two should be so bitten across as to make them crack or split in an opposite direction to that of their length. A bean which is easily fractured, and whose interior exhibits a dry and husky but not powdery appearance, is either old or has been kiln-dried or heated in the mow. But a bean in full possession of its vitality and of its capacities for speedy and vigorous germination, can be almost as easily bitten asunder in any other direction as down the middle, and cannot without difficulty be cracked or fractured, and exhibits a toughish and fresh-looking interior. When none but oldish beans can be obtained for seed, they ought to be sown fifteen or twenty days earlier than if they were fresh.

The Physiology of the Bean.—A bean of any of the larger varieties affords a remarkably distinct and most beautiful exemplification of the phenomena of germination and nascent vegetable growth. The cotyledons or seed-lobes are large and fine specimens of phytological albumen [see our second article ALBUMEN], and serve as stores or sources of suitable nourishment for the infant plant in a manner analogous to the albumen of eggs for embryo birds, or to the milk of the animal breast for the young of the animal. The plume, plumule, or germ of the future stem, is a very distinct small white point between the upper part of the cotyledons; and the radicle or germ of the future root, is an equally distinct small curved cone at their base. "The matter of the seed, when examined in its common state, appears dead and inert,—it exhibits neither the forms nor the functions of life; but let it be acted on by moisture, heat, and air, and its organized powers are soon distinctly developed. The cotyledons expand, the membranes burst, the radicle acquires new matter, descends into the soil, and the plume rises towards the free air. By degrees the cotyledons become vascular, and are converted into leaves, and the perfect plant appears above the soil." This is Sir Humphrey Davy's general description of vascular, or at least of dicotyledonous germination; and, in all its parts, it is most observably exemplified in the bean. When a bean seed is placed in humid soil, under a moderate degree of heat, either in the open air or with access to an atmospheric current, its cotyledons soon swell, burst their skin or enveloping membrane, and open like a bivalve shell. The radicle and the plumule now appear as a small oblong body, proceeding from the joint of the opened cotyledons; the radicle pushes rapidly

downward, to elongate and ramify itself into the stem and fibres of the root; and the plumule rises upward, carrying the cotyledons along with it, and exerting so mighty a mechanical force as easily to pierce the soil, and even, if necessary, to perforate or split asunder considerably cohesive clods. All this commencing growth of both the radicle and the plumule is effected by the decomposing power of moisture, air, and heat, upon a portion of the albuminous matter of the cotyledons, and by the assimilation of the products of the decomposition into the substance or organism of the nascent root and stem. The swelling cotyledons obtain oxygen by the imbibition of moisture and air; they give up a portion of their carbon to combine with this oxygen, and to go off with it in the gaseous form of carbonic acid; and they, in consequence, are, to a large degree, converted into a mild, milky, highly nutritious fluid, which is drunk up by the minute nascent vessels of the radicle and the plumule, and serves at once for the support of life, the increment of substance, and the full discharge of every organic function. The soil yields no aliment or influence whatever toward the nascent growth, but serves merely for the retention of moisture, the moderating of heat, and the mechanical anchoring of the root; and if it have been either ill pulverized or subsequently trodden, it offers an amount of resistance which much of the young plant's power is expended in overcoming. When a footpath is led across a field newly sown with beans, or when large indurated clods remain unbroken by the tillage, the nascent stem often makes long spiral evolutions in attempts to worm its way to the surface, and the cotyledons are drawn after it into the crevices which it makes, and sometimes are there held tight till released by the fall of rain. While the oxygenic action within the cotyledons is in progress, and while their originally hard substance is in consequence undergoing transmutation into the alimentary fluid, new and minute vessels are formed throughout to convey that fluid from every part of them to the growing radicle and plumule; and, at length, when the radicle is fairly formed into a young root, with its fibrous ramifications and its absorbing spongioles,—when the plumule rises above the soil, enjoys the influences of the open air, and assumes all the offices of a young stem,—when, in one word, the plant has passed out of its nursling condition, and has acquired the organs and the position for feeding itself with all requisite elements from the soil and the atmosphere, the cotyledons cease to yield nourishment, emerge above the soil, change into seed-leaves, and begin to assist the new mode of growth by elaborating the radical sap with the atmospheric gases. Who can contemplate this wondrous process, without observing both solemn and delightful evidences of the existence, wisdom, and power of the all-benevolent Creator?

Farm-cultivation of the Bean.—The south of

Ireland and the somewhat moist districts of the champaign parts of Great Britain, are much more favourable to the cultivation of the bean than either the mountain valleys or the comparatively arid plains. A very moist climate prevents the setting of the blossoms; and a very dry one occasions a destructive abundance of the bean fly. A climate of medium humidity is the most suitable; and a dry summer in such a climate, favours the production of the seed, and a wet one the luxuriance of the straw.

Rich clays and strong moist loams were formerly regarded as the only soils in which beans could be advantageously grown; but free loams and the richer kinds of light turnip soils have, for a considerable time past, been found almost equally suitable. A rich strong loam, such as is most favourable for wheat, is the best for the bean; and, if properly prepared, will produce a crop of fifty or even one hundred per cent. superior to the average crop of any soil of medium quality. A cold wet soil, or particularly a stiff retentive clay, appears, during the early growth, to be perfectly suitable; but it is far more favourable for the straw than for the seed, and, unless exceedingly well managed, yields but a poor return at harvest. The bean is an excellent substitute for a clean fallow upon inferior, wet, heavy land, exactly as the turnip is the cleaning, strengthening, consolidating, commencing, member of a rotation upon inferior, dry, light land; and the harvest appearance of these two crops, respectively upon the heavy and the light soils, affords one of the best possible criteria of the farmer's industry and skill, and a quite decisive indication of the artificial changes which have been effected on the mechanical and chemical condition of the land. The strong, penetrating, and ramified root of the bean, cleaves and subdivides the stiff soil, so as to draw down a free circulation of atmospheric air, and to dry, pulverize, and mellow the clayey earth; and its succulent leaves absorb a large amount of nourishment from the atmospheric gases, and, by their fall and decay, communicate the elements of most of that nourishment to the soil. A crop of beans, while eliminating nearly as much nutritious matter for the use of animals as a crop of wheat, produces a far less exhausting effect upon the soil; and, in general, but especially upon heavy land, it excels every other crop in making a remunerating return for manure, and in effecting a suitable preparation for oats or wheat.

The bean, from its habit of growth, and the manner in which it may be cultivated, is usually regarded as a cleaning crop, and made preparatory to corn; yet, owing to the different adaptations of its several varieties, and to the different methods of cultivation of which it admits, it may be very variously treated in systems of rotation. It may be sown on land broken up from grass, and will perfectly well succeed in such a case; yet it is not so suitable here as oats, and ought

in general to follow a corn crop, and to be treated as a substitute for a clean fallow. When regarded as an auxiliary to the profitable management of heavy soils, it prolongs the remunerating series of a rotation, or enables the farmer advantageously to postpone the recurrence of summer fallow. If a good bean soil be in a proper state of freedom from weeds, and have not been exhausted by overcropping, it may receive the bean either preparatory to corn or subsequently to corn, or, in favourable circumstances, may grow the two in alternation for a series of years; but when either weedy or exhausted, it ought, if a heavy soil, to be laid up to naked fallow, and, if a lightish soil, to be cropped with turnip. In the richest districts of Kent, beans and wheat—by cultivating the former in drills, giving plentiful doses of manure, and making a diligent use of the hoe—may, without any change or fallow, be grown many years in succession. Throughout the Isle of Thanet, the common rotation is barley, beans, and wheat; and in the district around Maidstone, the bean crop most commonly follows clover, but sometimes it follows wheat, or barley, or oats, and in a few instances it follows turnips. One rotation of six crops tried by Arthur Young, together with the produce of each of the crops per acre, was beans 24 bushels, beans 32 bushels, beans 40 bushels, cabbages 8½ tons, beans 32 bushels, and wheat 33 bushels; another was beans 24 bushels, barley 39 bushels, beans 32 bushels, barley 44 bushels, beans 33 bushels, and wheat 25 bushels; and another was beans 24 bushels, wheat 22½ bushels, beans 26½ bushels, wheat 27½ bushels, beans 24 bushels, and wheat 24 bushels. The chief use of these examples, however, is to show how much may be made of beans, or with what freedom and frequency they may recur,—certainly not to inculcate that, in any ordinary circumstances, they ought to be treated with such remarkable prominence. Probably the most profitable stated recurrence of the bean, on a moderately light loam, is in a rotation of turnips, barley, clover, beans, and wheat; or, on very richly conditioned loam, turnips, barley, clover, oats, beans, wheat, and beans.

Stubble land intended for beans should be ploughed as early in autumn as attention to the other duties of the farm will admit, and, in all cases, with as deep a furrow as the strength of the horses can accomplish. The bean is a perpendicular-rooted plant, extracting its peculiar nourishment from a considerable depth below the surface. The soil, therefore, should be deeply ploughed, not only that it may be duly mellowed by the frosts of winter, but that the root of the bean may be enabled freely to penetrate and ramify itself in search of its necessary aliment. Some farmers, with the view of giving only one spring ploughing, and that endlong, give the autumn ploughing across the lands or ridges; and others, intending to give two spring ploughings, give the autumn ploughing endlong. The

latter of these practices is greatly the preferable, especially on strong clays; for it lays the field in a better situation for throwing off moisture in winter, and for becoming sufficiently dry for the tilling and sowing operations in early spring. Yet all wet, adhesive land, no matter how naturally fertile, ought to have been previously relieved of its superabundant moisture by thorough draining; for as beans must necessarily be sown at a very early period in spring, an undrained field of this description can rarely be brought into a condition of mellow, pulverized tilth in sufficient time for the reception of the seed.

The amount and manner of preparatory tillage in spring, immediately before seed-time, vary in different districts, and obviously depend, in a great measure, on the character of the weather, and on the nature and condition of the soil. In good weather, light and well-drained lands are easily prepared; and in wet weather, ill-drained heavy lands cannot be even moderately prepared without a maximum degree of both skill and labour. Though spring ploughing for corn crops is now very generally superseded by easier tillage, yet on clayey soils, when beans are to be sown as a substitute for a fallow, two spring ploughings, preceded by an endlong autumn ploughing, are highly advantageous. The first of these ploughings should be given across the ridges, as early in spring as the land is sufficiently dry to admit of the operation; immediately afterwards, all the inter-furrows, furrows of the headlands, gaw-furrows, and cross-cuts, should be carefully opened up by the plough or shovel, in order to prevent the stagnation of surface-water; and the second spring ploughing may belong to the seed-process, and either form the drills for sowing, or receive the seeds under furrow. Harrowing and weed-gathering ought, in every practicable instance, to be prosecuted and repeated till the soil is thoroughly pulverized, and till as many roots as possible of *Triticum repens* and other vivacious weeds are removed. Yet in even the best bean-growing districts, many farmers, in dealing with wet or heavy land, form the drills on the winter-furrow,—some dispensing with all other spring tillage, and others adding only one good harrowing. In these cases, however, the deep, open furrows ought to be levelled in, and any root-weeds which are exposed by the plough in forming and reversing the drills, ought to be carefully collected and removed. "It would, perhaps, be found a judicious practice," says a writer in the *Farmer's Monthly Miscellany*, "to give strong adhesive soils, intended for beans, a course of tillage in autumn, or at any suitable opportunity before the severity of the winter season sets in. The land, after being ploughed and harrowed in a sufficient manner, may be formed into drills in the usual way, in which state it remains till the period of sowing arrives. The manure is then laid on in the hollows between the drills, the seed deposited by the sow-

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ing-machine, and all covered in by reversing or splitting the drills. The advantages resulting from this mode of autumn-tillage, are, that the soil is effectually pulverized by the action of the frost and other atmospheric changes during winter; many of the roots of perennial weeds, and the larvæ of insects, are destroyed by the same agency; and the land, by being formed into raised drills, is preserved in a dry condition during the winter months. By preparing the ground in this way in autumn, the seed can be sown at the proper season; the soil is finely pulverized and well prepared for its reception; and there is every favourable prospect of an abundant return in harvest."

The bean is a crop which makes an ample compensation for manuring; and when it figures in a rotation which is quite or nearly free from turnips, potatoes, and any similar crop, all the dung of the farm may be advantageously given to it as a preparation for wheat. The manure for it, of whatever quantity, is sometimes spread upon the surface, and ploughed in when giving the winter-furrow; and, in this case, the manure tends to keep a strong clayey soil loose and open in the bottom, and the land is in a state of considerable forwardness for the operations of early spring. Another and not infrequent practice is to apply one-half of the manure immediately before the autumn ploughing, and the other half immediately before the spring tillage. When either the whole or part is reserved till the latter season, it ought, at convenient times during the winter frosts, to be carted to some spot in the field, there laid in a heap, and, afterwards at a proper time before being required for use, turned over in order that it may undergo the requisite degree of fermentation; and, at seed-time, while the drills are being formed, it should be carted from the heap, dragged out in small portions into the hollows of every third or fifth drill, and distributed equally along the intervals. In the coast districts of the bean-growing baronies of Forth and Bargie, in the south-east of Ireland, fresh sea-weed is spread on the stubble land during autumn and early winter, and the bean-seed is ploughed into the ground in ridges immediately before Christmas; and in the interior districts of these baronies, composts of dung or sea-weed, earth, sand, and other materials are accumulated during autumn and early winter, and carted to the field and ploughed in at the time of sowing. But beans grown in these baronies—though owing partly to the inferior plant and the inferior culture, as well as to the manure—do not, in the Scottish markets, bring within five shillings of the price of those grown in the carses of Falkirk and Gowrie.

Beans may be either sown broadcast or dibbled or drilled. The broadcast method is commonly practised in Ireland; the dibbling method is extensively practised in England; and the drilling method is almost universal in Scotland. The

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broadcast method greatly economises time and labour, and in some rare instances perfectly serves all the purposes of the crop as to both the produce and the land; but, in general, it is most slovenly, wasteful, and pernicious,—occasioning a prodigal expenditure of seed, encouraging carelessness in tillage, cherishing the growth of weeds, preventing all the most useful operations of after-culture, and rendering the crop befouling and exhausting instead of cleansing and restorative.

Dibbling in rows at regular intervals, when the process is carefully performed, is a greatly superior method to broadcasting; yet though well suited to the cottier and the small farmer, it is far less adapted than the drill system to fields of considerable extent. It effects a considerable saving of seed, occasions perfect aeration to every plant, and induces flowering and podding at the lowest possible points of the stem; yet, on a large farm, it consumes an amount of time and labour, and involves a greatness of risk in reference to the vicissitudes of weather, which more than counterbalance its advantages. The absurd practice formerly prevailed in England of paying for dibbling according to the number of pecks or bushels of seed deposited; and this involved a powerful inducement to dishonesty and carelessness, and a corresponding risk of serious limitation of the crop from paucity of seed. But of late years dibbling-machines have been invented for the speedy performance of dibbling work upon a large scale; and these, though inferior in their mode of acting to hand-dibbling, give the farmer a power of greatly accelerating the work, and at the same time protect him from the consequences of irregular sowing. See the article *DIBBLE*.

Drill-sowing is effected in two or three different methods, according to the kind of the preparatory tillage, the nature of the soil, the intended amount of after-culture, and the character of the weather. When a previous spring-ploughing has been given across the ridges of the autumn ploughing, the lands or ridges are divided by the plough into hollow drills with intervening ridgelets, or one-bout stitches, at intervals of 26 or 27 inches. When manure is to be applied, the seed is first sown, the manure is then drawn out and divided in the manner formerly noticed, and the high drills or ridgelets are next split out or reversed, by means either of the common plough, or of a plough with two mould-boards.—In another mode of drill-sowing, the manure is spread over the surface of the winter furrow, and both this manure is ploughed in and the seed is sown, simultaneously with a single spring-ploughing. Three ploughs start in succession, the second immediately after the first, and the third immediately after the second; a drill-barrow or sowing-machine is fixed between the handles of the third plough; and the seeds are thus deposited in every third furrow, and covered by the

succeeding furrow-slice. This mode of sowing may, of course, be so extended on a large farm as to have either six or nine ploughs in simultaneous operation.—Another and better method, when manure is applied at seed-time, is to plough down the spread manure with a strong furrow, and afterwards to draw light furrows for the reception of the seed. But whichever of the methods be practised, the whole field ought, in every necessary place, to be carefully and industriously water-furrowed, by means of the plough and the shovel. The time of sowing is as early as possible after the severity of winter is past,—at Christmas if the climate, as in the south of Ireland, is very mild,—in February, if possible, throughout even the coldest parts of Scotland,—and never, in any district, later than the end of March.

Much difference of practice prevails, in both the dibbling and the drilling systems, as to the distance between each row of seeds. Some English farmers form their bean-rows at distances of 9 or 10 inches, others at distances of 15 inches, and others in double rows of 4 inches asunder, at exterior distances of 18 inches. But in all such instances, hand-hoeing alone can be brought into requisition in the after-culture; and this is comparatively inefficient for eradicating weeds, and keeping the soil clean and pulverulent, on heavy land. Drill-rows are sometimes formed at distances from one another of three yards, and ought never to be formed at smaller distances than about 27 inches; for an ample width between them, is not only indispensable for the important operations of horse-hoeing, but also occasions a healthy and even requisite circulation of air.

The quantity of seed considerably varies according to the character of the soil, the condition of the tillage, the method of culture, and the variety of the seed. But, in average cases, with the common horse bean, five bushels per acre is a proper quantity broadcast, four bushels when sown in drills, and two or at most three bushels when dibbled. But in England, in consequence of the climate being more favourable for the ripening of the bean than in Scotland, the proper quantity of seed is considerably smaller. A thinly sown crop seldom succeeds well in Scotland, except upon very rich soil.—An useful practice, in either broadcast or drill sowing, is to mix about a bushel of pease or vetches with every six bushels of the beans; for the pease considerably improve both the quantity and the quality of the fodder, and they also serve at harvest for binding up the beans into sheaves. A mixed crop of this kind is called, in the agricultural language of Scotland, a crop of beans with a dropping pea.—The depth at which harrowing deposits broadcast seed, is necessarily very variable and quite uncertain; the depth of deposition by drilling after the plough, or in what may be called ploughing under, is from 3 to 4 inches;

and the depth, in the better and more accurate method of sowing in hollow drills, covered over by the splitting or reversing of the ridgelets, is originally much deeper, but is afterwards reduced to 4 or 5 inches by the harrowing down of the ridgelets into the hollow interspaces.

A new method of bean culture was commenced a number of years ago on M. de Fellenberg's farm at Hofwyl in Switzerland, and has since been successfully practised, for several years, at Ockham Park in England. It consists in so treating beans and cabbages, that a fair crop of both is obtained from the same land in a single season. In February, the beans are dibbled in double rows at 4 inches asunder from each other, and at exterior distances of 3 feet; and these wide exterior distances permit the subsoil plough or the double mould-board plough to pass freely along, without injury to the beans, as often as the state of the soil may require till the planting of the cabbages. The cabbages are sown in a garden seed-bed in the previous autumn, pricked out in a corner of the garden in March, and planted between the rows of beans in the field in May or June. They are of the thousand-headed variety, and are planted at distances from one another in the row of about two feet, and ought to be from 5 to 8 inches out of the ground. The beans are generally removed early in August; the space which they occupied is then ploughed; and the cabbages, though hitherto restrained in growth, now grow with such rapidity as effectually to prevent any considerable growth of weeds. The cabbages yield a great bulk of green food towards Christmas, and, if then stripped of their leaves, produce a second sprouting at the end of March or beginning of April. But as food for breeding stock is much more important in early spring than at Christmas, the cabbages may be left untouched till the supply of turnips is exhausted; and then, in the latter part of March and early part of April, they may be eaten off the ground in couples. The quantity of keep afforded by them, in the latter mode of consumption, is equal to that which would be yielded by the same area of many kinds of turnips; and immediately after their being eaten off, the land needs but a single ploughing to be ready for the reception of spring corn. The yield of the bean crop, too, so far from being diminished by the great width of the rows and the accompaniment of the cabbages, was found at Ockham Park to be actually increased; for the average annual produce during five years previous to the adoption of the new method was 35 bushels per acre, and the average annual produce during five years of the accompaniment of the cabbages was 41 bushels.

The after-culture of the bean, in all the ordinary methods, is somewhat operose and not a little important. In cases of broadcast sowing, the harrow is used of course to cover in the seed; but it is also used afterwards, in order to destroy

young annual weeds, either immediately before the plants appear at the surface, or just after they are fairly above ground, and have transmuted their cotyledons into seed-leaves. The young bean plants, between the time of their appearing at the surface and the time of their obtaining their first green leaves, are so brittle that their necks would be broken by the harrow; but afterwards they yield without fracture, and receive benefit rather than injury from the implement, while, of course, a greater amount of annual weedy growth is destroyed. When the beans are sown in drills, the harrow ought to be used ten or twelve days after the sowing, or as soon after that number of days as the weather will permit. The harrowing is given across the drills so as at once to level down their summits, to destroy the annual weeds which have vegetated, and to lay the soil level for the subsequent operation of hoeing. The grass-seed harrow, or even the common harrow, is very commonly employed; but the kind of curved drill-harrow, used in some districts, to perform a similar office in the cultivation of the potato, is to be preferred. This implement consists of two light curved harrows, adapted to the curvature of the drills, and drawn by one horse. The two parts are mutually connected, and severally provided with handles; and by means of these handles, the workman keeps them fair on the drills, and disengages them from weeds, large clods, or other obstructions. If the field is at all likely to retain any surface water, the replacing of all the water-furrows must be carefully attended to, both after the harrowing, and after the subsequent cleaning operations.

These subsequent operations consist of repeated horse-hoeings, hand-hoeings, and hand-weedings, and ought, in every instance, to be performed when the ground is in a medium condition between wet and dry. Before the introduction of the horse-hoe, a common small plough, drawn by one horse, was driven once up and once down in the interval between every two drills, gathering the soil from the drills into a ridgelet in the middle of the interval; a hand-hoeing was then given, to cut the weeds close to the rows; a second hand-hoeing followed, to destroy any fresh growth of weeds; and, some time after, a small double mould-board plough, also drawn by one horse, split open the ridgelet in the middle of the interval, and laid it up as an earthing against the sides of the drills. The implements now generally used, in addition to the common small one-horse plough, are various kinds of drill-harrows or grubbers, provided with different sets and shapes of coulters and tines, and powerfully adapted to destroy weeds and pulverize the soil. The small plough, when employed, first pares away a portion of the sides of each drill; and the scraper, grubber, or drill-harrow then follows to reduce, level, and clean this removed portion of the soil. But the plough is really not needed;

for the most improved drill-grubbers can perfectly perform the whole work without its aid. Wilkie's drill-grubber or horse-hoe, in particular, is a most effective implement: its first or central coulter has a double-feathered sole; its other two coulters are only single-feathered, and are so prolonged and hinge-jointed at top as to be capable of expansion and contraction; and while these coulters are admirably adapted for cutting all weeds, a small attached harrow follows, and brings the cut weeds to the surface. Another excellent and very suitable implement is a spiked roller, of such size as to suit the interval between the rows, its spikes capable of being removed from the cylinder so as to convert the implement into a scarifier or a grubber, its frame provided with a cross-bar for the attachment of different kinds of coulters and tines, and its point mounted on a small wheel to facilitate the transit from interval to interval at the end of the rows. After horse-hoeing or drill-grubbing has done its utmost, some women and boys, or some otherwise disengaged men, must give a thorough hand-hoeing, in order to remove whatever weeds may have escaped the horse-hoeing, or may be situated beyond its reach. These operations ought to be repeated from time to time till all weeds are thoroughly exterminated, or till the bean-plants have attained so forward a growth that any farther tillage would be injurious rather than beneficial. A well-managed field of beans ought to be as clean as a garden bed, and always is so under the care of an industrious farmer. Nothing can be a grosser outrage upon every principle of good husbandry, or can more effectually defeat the luxuriance of the cultivated crop itself, or the preparatory tilth for the corn crop of the following year, than for a crop of beans to labour hard for subsistence amidst a choking growth of weeds. A common practice, after the several hoeing and weeding processes are concluded, is to raise a portion of the soil up to the stems of the plants, in the same manner as is done with potatoes. When the land is undrained and of a retentive nature, this practice facilitates the escape of surface-water, and tends to preserve the crop in a dry position; but, in other circumstances, it has scarcely any other effect than to prevent the reapers from cutting the plants sufficiently near the root in harvest, and to occasion inconvenience in afterwards ploughing up the land for wheat.

Topping of the Bean.—The removal of the tops of bean-stems by lopping or nipping is almost universally a part of bean-culture in the garden, and is sometimes advantageously practised in the field. The principal object of it is to avert the devastations of the minute insect called the bean-dolphin; and subordinate objects are to invigorate the flowering, and induce comparative regularity in ripening. The structure and habits of the bean-dolphin have already been noticed in the article APHIS. Fumigating with sulphur has

been tried against the insect; but has seldom if ever been successful without being of such strength as greatly to damage the plants; and the removal of the tops is the only known effectual remedy. The honey-dew which accompanies the appearance of the aphid usually begins to be observed about the middle of May, and is in many districts popularly called the mildew; it indicates itself by embrowning the points of the leaves; it afterwards extends over the whole surface of the leaves, and deepens the embrowning into black; and, if unchecked, it eventually blights all the fructification, and kills the plant. The insect itself, which is of a coal black colour, makes its first appearance on the summit of the stem; and, if not dislodged, it soon swarms over the whole of the top leaves, and eventually spreads down the stem, and multiplies in myriads till the succulency and the very vitality of the plant perish. But if the progress of the flowering be watched, some ants may be observed on the ground around the plants; and their presence is a certain indication that honey-dew is in the course of origination, and therefore a practical hint that the time has arrived for the operation of topping. See the article ANT. This operation is performed either by a man walking along the intervals between the rows, and cutting off the heads of the plants with a sword-blade or with a small scythe set in a handle, or by women and children passing close along the side of the rows, and pinching off the heads of the plants with their hands. In the former method, the loppings ought afterwards to be gathered from the ground, and removed from the field; and in the latter, they may be deposited in bags or aprons, and emptied from time to time into a cart. Operators pinching with both hands will perform the work with far more expedition than would at first thought be supposed possible, and their labour amounts, in extreme cases, to the actual saving of the whole crop.

Harvesting of the Bean.—In a cold and humid climate, the harvest management of the bean, on account of the succulency of the plant, and the lateness and irregularity of its ripening, is peculiarly difficult. The crop ought to be well ripened before being cut, for otherwise it will not easily be brought into a dry enough condition for being ricked, it will incur serious risk of injury from unfavourable changes in the weather, and it will, in any event, suffer considerable deterioration in its quality. If allowed to become over ripe, some of the seed will be lost by shedding, and much of the remainder will acquire a dark colour in its outer skin, and occasion a diminution in the market value of the sample; and if not allowed to become ripe enough, the pods will shrink and deteriorate, and the haulm will incur great risk of partial or even total fermentation. After the eye of the seed is thoroughly blackened, and the skin has acquired a yellowish and leathery colour and texture, even

though the pod should be neither black nor dry, the crop is in a fit condition for being cut down. When wheat follows the bean, the latter ought not to remain uncut after the first week of October; and, should any obstruction occur to a sufficiently early housing of the crop, it ought, immediately after being bound into sheaves, to be removed to another field to be dried. The expense of twice removing it—first to another field, and afterwards to the rick-yard—will be very richly compensated by the superior yield from duly sown wheat, or especially by escaping the risk of being compelled to withhold wheat and substitute barley.

A somewhat common method of reaping beans, is with old sickles which are not fit for reaping corn; another very common method, called bagging, is with an instrument in the form of a sickle, but broader in the blade, and as sharp as a scythe; and another method, though not so common, is to mow them. Whichever of these methods is practised, the crop ought to be cut as near as possible to the ground, both that as much of the straw as possible may be secured for fodder, and because the best pods are often situated very near the base of the stems. A fourth method, when the haulm is short, as in the case of the Mazagan bean, is to pull up the crop by the roots, and this method has the recommendation of leaving the land in a state of far better tilth than if the crop were cut; but it requires a comparatively large number of workpeople, is difficult or nearly impossible on firm or adhesive soils, entails the duty of a very careful cleaning of the roots previous to the operation of thrashing, and, in almost any case, is unsuited to the economy of an extensive farm.

The reaped crop ought to be left for a few days in the swathe if mown, or in loose broad-band quantities if cut with the sickle; and when the plants have somewhat lost their succulency, or begin to be comparatively dry, they ought to be bound into very small sheaves, either with the twisted haulm of intermixedly grown pease, or with bands of straw, hop-bine, or yarn. The sheaves should be set on their butts, to dry, in double rows or stooks, without any hoods or riders; or if a prolongation of moist weather be apprehended, they may be piled into small round ricks, so constructed as to admit a free and searching circulation of air.

Beans continue to incur considerable risk even in the rick-yard, and must be stored there with careful regard to their being kept dry and ventilated, so as to escape mould or heating. They may be built in round ricks in the same manner as wheat; but whenever these ricks are not very small, each should be constructed with a boss, or conical opening through the centre from the base to the top, so as to permit a free and constant circulation of air. But when the crop is large, a better method of storing is in large oblong stacks, resembling a house in outline, and constructed

with a considerable number of both vertical and horizontal subdivisions. The top of such a stack is formed and thatched like the roof of a house, and does not impose its weight upon the beans; its subdivisions are made by cross-rails, which serve the double purpose of preventing pressure and permitting ventilation; its base rests on saddles, which cut off all direct communication with the ground; and the portion of beans within each of its subdivisions has a perfectly separate or independent lodgment, so that the stack can be diminished piecemeal to suit the minutest conveniences of thrashing or consumption. The cost of the frame-work of such a stack, including saddles, and measuring 40 feet at the base, about 44 feet in length, and about 18 feet in height at the eaves, needs not be more than at the utmost £12; and, if properly used, it will last during many years.

Beans may be thrashed either with the flail or with the thrashing-machine; and they are dressed by the winnowing-machine in the same manner as corn; but, in the process of riddling, all their light seeds and broken shells ought to be carefully skimmed off with the hand. Thrashing by the flail is better suited to progressive consumption, and to the preservation of comparative succulency than thrashing by machinery: and it ought, therefore, to be preferred in every instance when the haulm is given as food to working horses.

Produce of the Bean.—The bean is the most uncertain and fickle of all the field crops of Great Britain, except pease, and ranges from a degree above mere worthlessness to a degree supereminently remunerating. The amount of produce is affected not only by the habits of the plant itself, but very powerfully by culture, weather, and the aggregate of agricultural accidents. Professor Low says, "Forty bushels to the acre are regarded as a great crop; thirty bushels are a full and satisfactory one; and probably the average produce of the kingdom does not amount to twenty-four." Sir John Sinclair says, "A good crop of beans on a fit soil, well managed, and in favourable seasons, may sometimes exceed 42 bushels per statute acre, but from 24 to 32 bushels are reckoned a satisfactory produce. In unfavourable seasons, even on very good soils, the crop sometimes turns out almost an entire blank, so far as the grain produce is concerned, and not worth thrashing, except to clean the straw from soil and mouldiness, before using it as fodder." And Loudon, exhibiting the opinions of several other eminent agriculturists, says, "The produce of beans, when proper management is exercised, and where diseases have not occurred, is generally from 25 to 35 bushels per acre. Donaldson says that a crop of beans, taking the island at large, may be supposed to vary from 16 to 40 bushels, but that a good average crop cannot be reckoned to exceed 20. In Middlesex, Middleton tells us, that bean crops vary from 10 to 80 bushels per

acre. Foot says the average produce is from $3\frac{1}{2}$ to 4 quarters per acre. In Kent, A. Young thinks, they probably exceed 4 quarters; but in Suffolk he should not estimate them at more than 3; yet 5 or 6 are not uncommon."

Farm-Uses of the Bean.—Beans are better suited for feeding horses, and are more nutritious, than oats; and they ought, when thus used, to be split or bruised in a mill, and given in mixture with cut or chaffed hay or straw. When beans are given whole to horses, they are liable to be swallowed without proper mastication, and to cause indigestion and a laboured action of the lungs. Beans, given first whole, and afterwards ground, are very extensively employed in England for the fattening of hogs; and as they have a tendency to render the pork very firm and not sufficiently delicate, they are usually superseded, in the last stage of fattening, by barley meal. Bean meal is also well adapted to the fattening of oxen, and renders their flesh better flavoured than oil-cake does; and when mixed with the drink of cows, it very materially increases their yield of milk. Millers in England allege that new or soft wheat will not grind without the mixture of a small quantity of beans; and they generally make this mixture far larger than even their own allegation asserts to be necessary. The adulteration of wheat-flour with beans is known to almost all flour-dealers and bakers; it can easily be detected, and is usually allowed for, in wholesale purchases; and it in consequence imposes only on a few ignorant purchasers and on the retail consumers.

In Scotland, beans are used, either whole or broken, and mixed with oats, for feeding farm-horses; between the close of turnips and the commencement of pasture, for fattening cattle; and in districts where grain payments prevail, and where the ordinary household bread is made of barley meal mixed with pease meal or bean meal, for the partial payment of farm-servants. When bean meal is given to cattle, great care ought to be taken that each beast eat no more than its proper quota; for a master ox, if not restrained, may devour far more than his share, and may die of a surfeit.—Bean straw, especially when mixed with that of pease, is of great value as fodder for working-horses; and, when well harvested, is reckoned very hearty feeding. But, in some working-horses, and in all riding-horses, this food is apt to produce extreme flatulence, colic pains, and a painful action of the lungs. Bean stubbles, if the crop have been properly cultivated and harvested, are of small value, and, when wheat follows, require to be speedily ploughed in; yet, in some miserable instances, when very censurable cultivation occasions the ground to be matted with couch, knotgrass, and other vivacious weeds, these stubbles are apparently excellent pastures.

Garden cultivation of the Bean.—Beans are sown in the open ground of the garden from Oc-

tober till near the end of June; and when raised as a luxury for the tables of the rich, they are occasionally forced by artificial heat. They prefer, like field beans, a rather strong, rich, moist soil, yet will succeed in almost any kitchen-garden mould. The seeds should be dropt regularly into drills at three, four, or five inches distance from seed to seed, according to the comparative size of the plants. The soil should be pressed firmly upon the seeds; as the plants advance, they should receive a little earthing up, and the spaces between the rows should be kept free from weeds; when the blossoms expand, the tops of the stems ought to be nipped off; and if the bean-dolphin should obtain complete possession previous to the removal of the tops, the plants ought to be cut down to within five or six inches of the soil, and all the loppings carried away. The quantity of seed of the smaller early varieties, required for a row of eighty feet, is about a pint; and for the main crops, when the seeds are planted further apart, the quantity is proportionally less.

The kind of bean sown in the various successions, from the end of October to the end of January, is the small early Mazagan. In the warmer counties of England and Ireland, this bean, for all these successions, may be sown in any sheltered situation, which enjoys an exposure to the sun; but in the colder counties, and throughout Scotland, it ought to be raised on a small warm seed-bed, and afterwards transplanted. The seed-bed may be about six feet square; the soil must be reduced to a fine powdery condition; small drills must be made three inches asunder, two inches deep, and very solid and even at the bottom; the seeds must be sown at distances of about three inches, and covered with fine soil, firmly pressed around them; the seed-bed must be protected either by a frame and lights, or by an archwork of hoops covered with mats, or by some equally effective contrivance; and the coverings must be removed in mild weather, and free airings otherwise given with all possible frequency. Open ground for the final growth of the plants must be prepared by manuring, digging, and pulverizing; drills must be made in it, two feet apart, and sufficiently deep to receive the mass of roots; and in settled weather, in February, or early in March, the plants must be transplanted into these drills, the soil being brought into close contact with their fibres, and earthed up to the height of two inches around their stems.—The long-pod varieties may be sown from the first week of February till the end of May, in drills three feet asunder, and two or three inches deep; and the other varieties, described in a former section of this article, may be sown in the order of their respective lateness of habit,—the Windsor varieties being usually selected for the main crop.

Analysis of the Bean.—The ashes of the bean, according to Buchner, contain 68.59 per cent. of

phosphates of potash and soda, 9.35 of phosphate of lime, 19.11 of phosphate of magnesia, 1.84 of sulphate of potash and chloride of sodium, and 1.11 of silicate of potash. The bean itself, according to Sir Humphrey Davy, on the authority of Einhoff, in every 3,840 parts, contains 1,312 parts of starch, 31 of albumen, and 1,204 of other nutritive matters, such as gum, starch, and fibrin. Every 100 pounds of beans, according to Professor Johnston, contain 40 pounds of starchy substances, and 28 pounds of albuminous matter; and from two to three pounds of beans, according to the same authority, contain as much nourishment for cattle as 10 pounds of hay, 5 of oats, 60 of turnips, 35 of carrots, 28 of potatoes, 55 of oat straw, or 52 of wheat straw.—*Dickson's Agriculture of the Ancients*.—*Young's Farmer's Calendar*.—*Marshall's Rural Economy of the Southern Counties*.—*Mill's Husbandry*.—*Lawson's Agriculturist's Manual*.—*Sir John Sinclair's General Report of Scotland*.—*Hunter's Geological Essays*.—*Brown on Rural Affairs*.—*Agricultural Report of Berwickshire*.—*Loudon's Hortus Britannicus*.—*Catalogue of the Highland Society's Museum*.—*Magazine of Domestic Economy*.—*Treatise on British Husbandry*.—*Sproule's Treatise on Agriculture*.—*Low's Elements of Agriculture*.—*Doyle's Practical Husbandry*.—*Miller's Dictionary*.—*Davy's Agricultural Chemistry*.—*Liebig's Chemistry of Agriculture*.—*Farmer's Monthly Miscellany*.—*Quarterly Journal of Agriculture*.—*Journal of the Royal Agricultural Society of England*.

BEAN (KIDNEY). See KIDNEY-BEAN.

BEAN-DOLPHIN, or BEAN-FLY. See APHIS.

BEAN-GOOSE, — called by some zoologists *Anser ferus*, and by others *Anser segetum*. A species of wild goose, known to multitudes of British farmers for its depredations upon young crops of winter wheat. It is liable to be confounded by a careless observer, with the greylag, the origin of our domestic goose. But its body is of smaller size than that of the greylag; its bill is shorter and more compressed; its wings extend beyond the tail; and its mandibles are partly black, while those of the greylag are of an orange red. It inhabits the arctic regions during summer, and migrates southward to the British islands in autumn. "In Britain," says Mr. Selby, "it is well known as a regular winter visitant, arriving in large bodies, from its northern summer haunts, during September or the beginning of October, and seldom taking its final departure before the end of April or the beginning of May. The various flocks, during their residence in this country, have each their particular haunts or feeding districts, to which, on each ensuing season, they invariably return. They feed much upon the tender wheat, sometimes injuring the fields to a great extent; and they frequent also the stubbles, particularly such as are laid down with clover and other grasses. In the early part of spring, they often alight upon the newly sown bean and pea fields, picking up

greedily such of the pulse as is left on the surface; and I am inclined to think that their trivial name has been acquired from their apparent predilection for beans as food, rather than from the shape and aspect of the nail of the upper mandible, to which it has been generally attributed. In bulk, the bean-goose is generally rather less than the greylag, or true wild-goose; and it is accordingly sometimes called provincially the small grey goose; but it not unfrequently equals the other in size and weight. The head and upper part of the neck incline to brown with a greyish tinge, and the feathers of the latter hue are so disposed as almost to produce a furrowed appearance. The lower parts of the body are ash-grey, with transverse darker shades; and the back and scapulars are brown with a grey tinge, the feathers being edged with white."

BEAN-TREFOIL. See ANAGRIS.

BEAR, or BERE. See BARLEY.

BEARBERRY. See ARBUTUS.

BEARBIND. See BINDWEED.

BEARD. The awns of a plant; also the hairs on the underlip of a horse.

BEARDED-OATGRASS. See AVENA.

BEARDGRASS, — botanically *Polypogon*. A genus of grasses, of the agrostis tribe. Two species are indigenous in Great Britain; three species have been introduced from Tartary, North America, and the south of Europe; and nine or ten other species are known to botanists. All the five kinds existing in Britain are annuals, and of very little interest to the farmer; yet the two indigenous kinds have a pretty appearance, and are somewhat rare. The Montpellier species, *Polypogon Monspeliensis*, grows by road-sides; and the shore species, *Polypogon littoralis*—formerly called *Agrostis littoralis*—grows by the sea-side.

BEARING-REIN. The rein which occasions the bit to press most effectually on the jaw of the horse, and which compels the animal to carry his head high, corrects his tendency to stumble, and holds him in check when he is disposed to run away. It is useful on level ground, indispensable in fastwork, and generally necessary to a horse who has become accustomed to it; yet it prevents him from throwing his whole weight into the collar when ascending an acclivity, and is often, through useless and cruel inconsideration, made so tight as to excoriate the angles of his lips, and painfully cramp the muscles of his head. Yet, says a judicious writer in the *New Sporting Magazine*, "The charge against it of cruelty at once falls to the ground, because to make a team work together in fastwork, every horse's head must be as much restrained by the coupling rein as it would be and is by the bearing rein. Its excellence consists in keeping horses' mouths fresh, in enabling a coachman to indulge a horse with liberty of rein, without letting him be all abroad, which he would be with his head quite loose, and of additional safety to

the coach horse, as proved by the fact of either that or the crupper always giving way when he falls down. There are, however, teams in which it may be dispensed with, and the horses have an advantage in their working against hills."

BEAR'S BREACH. See ACANTHUS.

BEAR'S EAR. See AURICULA.

BEAST. Any quadruped which is used for labour or fed for the shambles.

BEATERS. The parts of the thrashing-machine which beat out the grain, and the parts of any other machine which have a beating action.

BECCABUNGA, or BROOKLIME,—botanically *Veronica Beccabunga*. A perennial, herbaceous, evergreen, aquatic plant, of the speedwell genus. It grows wild in the rivulets and clear ditches of Great Britain; and has been cultivated for medical and esculent purposes. Its stem is procumbent or floating, usually grows to the length of two feet, gives off from its joints long, simple, fibrous roots, and is round, leafy, smooth, and shining; its leaves occur in mutually opposite pairs, stand on short footstalks, and are oval, serrated, somewhat fleshy, punctured, and of a pale green colour; and its flowers occur in opposite axillary clusters, stand on delicate footstalks, are of a blue colour, and bloom in July and August. The plant has no odour, but, when much chewed, has a bitterish and slightly astringent taste. It was formerly regarded by pharmacologists as a good antiscorbutic; but it has too feeble a power to be effective unless it were to be used as food. It may be eaten as a salad, but ought to be used fresh.

BECKMANNIA. See CYNOSURUS.

BEDS. Long spaces occupied with corn, in the drill husbandry, and separated from one another by alleys; also small spaces of any extent, occupied with the minor crops of the garden, or forming the subdivisions of large borders.

BEDSTRAW,—botanically *Galium*. A numerous genus of herbaceous plants, of the madder tribe. Several of the best known species are popularly called cheese-rennet, ladies' bedstraw, yellow ladies' bedstraw, maid's-hair, petty mugwort, and yellow goosegrass. The common species or true cheese-rennet, *Galium verum*, grows wild, and in great abundance, in bushy places, in hedges, and by the sides of pastures, in Great Britain; and though a mere weed, possesses some little interest and value for its economical adaptations. Its stem is smooth, slender, reclining, and about 18 inches in length; its leaves are linear, smooth, and dark green, and occur in eight together; its flowers are monopetalous and bright yellow, occur in long, loose, terminal spikes, and bloom in July and August; and its roots are long and spreading. Its flowering tops, boiled in alum, dye a bright yellow colour: its roots yield a red dye quite equal to that of madder; and the whole of the plant, when bruised, has the property of curdling milk, and

is sometimes used for both colouring and flavouring milk intended for cheese. Both its popular name of cheese-rennet and its botanical name of *galium* allude to its property of curdling and colouring milk. It was at one time, by the recommendation of the Committee of the Council for Trade, attempted to be cultivated as a substitute for madder, and was found to produce about 12½ cwts. of dried roots per acre. It is eaten by sheep and goats, rejected by horses and swine, and not liked by black cattle; and it is said to possess the property of colouring the milk and the bones of such animals as eat it. It can be easily and rapidly propagated by the dividing of its roots in either spring or autumn; and it will grow in almost any soil or situation.

Twelve other species of bedstraw are indigenous in Great Britain; and several of these, particularly *G. mollugo*, *G. sylvaticum*, and *G. boreale*, possess the same economical properties as the common species, but not in so great a degree. Withering's species, *G. Witheringii*, is a perennial weed, with white flowers, on the heathy grounds of England. The marsh species, *G. uliginosum*, is a low, inconspicuous, creeping perennial weed of British marshes. The great hedge species, *G. mollugo*, is a creeping perennial weed, with white flowers, and a stem two feet long, in British hedges. The small species, *G. pusillum*, is an inconspicuous perennial weed of the English mountains. The English species, *G. anglica*, is a low perennial weed, with yellow flowers, in England and Wales. The rock species, *G. saxatile*, is a small perennial weed, with white flowers, on British moors. The three-horned species, *G. tricornue*, is a small annual weed, with white flowers, on British moors. The spurious species, *G. spurium*, is a trailing annual weed, with green flowers, in British cornfields. The northern species, *G. boreale*, is a trailing perennial weed, with white flowers, and a stem 18 inches long, on the British mountains. The species called the cleavers, *G. aparine*, is a twining annual weed, with white flowers, and a stem 3 feet long, in the hedges of Britain.—Between sixty and seventy species, some annual, but by far the greater number perennial, have been introduced from foreign countries; but none are suited to field cultivation, and only three or four—particularly *G. tauricum*, *G. purpureum*, and *G. rubrum*—are ornamental in the garden.—A hothouse evergreen undershrub from Mexico, and called by some botanists *Hedysarum aparines*, and by others *Desmodium aparines*, bears also the popular name of bedstraw.

BEE. A species of hymenopterous insect, belonging to the family Apiaria.—The honey-bee is universally celebrated for its singular instincts, and highly prized for the valuable products of its industry. A vast number of interesting facts have consequently been collected in relation to the economy of the species, for the detail of whose history a volume of considerable size would be

required. We shall therefore be able to present nothing more than a sketch of the most striking generalities, obtained from the admirable works of Huber, Cuvier, &c., and to these authentic sources must refer the reader desirous of more ample information.

Three sorts of individuals are found to form a community of honey-bees; the female, mother, or, as she is commonly called, *queen*; the males, or drones; and the working bees, improperly termed *neuters*, as they are actually females, though, in a peculiar respect, imperfect. A hive commonly consists of one mother or queen, from 6 to 800 males, and from 15 to 20,000 working bees. The last mentioned are the smallest, have 12 joints to their antennæ, and 6 abdominal rings: the first joint or square portion of the posterior tarsi is enlarged at the posterior angle of its base, and shaped like a pointed auricle, having its internal surface covered with a fine, short, close, silky down. They are provided with stings. The mandibles are spoon-shaped, and not dentated. There is, on the outside of the hind legs, a smooth hollow, edged with hairs, called the *basket*: the silky brush of the first joint of the posterior tarsi has 7 or 8 transverse striæ. The mother, or queen, has the same characteristics, but is of larger size, especially in the abdomen: she has a shorter sucker or trunk, and the mandibles grooved and velvet-like beneath the tip. The males, or drones, differ from both the preceding by having 13 joints to the antennæ; a rounded head, with larger eyes, elongated and united at the summit; smaller and more velvety mandibles, and shorter anterior feet, the two first of which are arched. They have no auricular dilatation nor silky brush on the square part of the posterior tarsi, and are destitute of stings. The genitals consist of two horn-shaped bodies of a reddish-yellow colour, with a broad-ended penis.—When we examine the internal structure of this insect, we find at the superior base of the trunk or sucker, below the labrum, a considerable aperture, shut by a small, triangular piece which has been called tongue, epipharynx, &c. This opening receives the food, which is thence conveyed by a delicate œsophagus, through the corselet, to the anterior stomach, which contains the honey; the second stomach receives the pollen of flowers, and has, on its internal surface, a number of transverse and annular wrinkles. The abdominal cavity of the queen and working bees also contains the little bag of poison communicating with the sting. In the queen there are, moreover, two large ovaries, consisting of a great number of small cavities, each containing 16 or 17 eggs. These ovaries open near the anus, previous to which they dilate into pouches, where the egg is delayed to receive a viscous coating from an adjacent gland. The inferior half-circles, except the first and last, on the abdomens of working bees, have each on their inner surface two cavi-

ties, where the wax is formed in layers, and comes out from between the abdominal rings. Below these cavities is a particular membrane, formed of a very small, hexagonally-meshed network, which is connected with the membrane lining the walls of the abdominal cavity.

Besides the distinctions remarked in the female, male and working bees, Huber regards the working bees as of two sorts; one devoted to the collection of provisions, and all the materials necessary to the comb, as well as to its construction; these he calls *cirières*. The others are more delicate, small and feeble, and employed exclusively within the hive, in feeding and taking care of the young.—The resemblance existing between the working and female bees first led to the idea that they were of the same sex, and the ingenious experiments and accurate observations of Huber enabled him to establish this fact in a most satisfactory manner. Having deprived a hive of the mother or queen, he found that the working bees immediately began to prepare a larve of their own class to occupy this important station. This was effected by enlarging the cell to the dimensions of a maternal or royal chamber, and feeding the selected individual on food exclusively destined for the nourishment of the royal larves. If merely fed upon this food, without an accompanying enlargement of the cell, the maternal faculties were but imperfectly acquired, as the female did not attain the proper size, and was incapable of laying any eggs but those which produced males.—The cells of the comb compose two opposite ranges of horizontal hexagons, with pyramidal bases: each layer of the comb is perpendicular, and attached by the summit, and separated from the rest by a space sufficient for the bees to pass in and out. The comb is always built from above downward. The cells, with the exception of those for the female larve and nymph, are nearly of equal size, some containing the progeny, and others the honey and pollen of flowers. Some honey cells are left open, others are closed for future use by a flat or slightly convex covering of wax. The maternal or regal cells vary from 2 to 40 in number, are greatly superior in size, nearly cylindrical, and somewhat larger at the extremity. They have small cavities on the outside, and commonly depend from the comb like stalactites, so that the larve has its head downwards.—The season of fecundation occurs about the beginning of summer, and the meeting between the females and males takes place high in the air, whence the female returns with the sexual parts of the male attached to the extremity of the abdomen. This one fecundation is thought to be sufficient to vivify the eggs which the mother may lay in the course of two years. The laying begins immediately afterwards, and continues until autumn. Reaumur states that the female, in the spring, lays as many as 12,000 eggs in the lapse of 24 days. Each sort of egg is deposited in the appropriate cell, unless

a sufficient number of cells have not been prepared: in this case, she places several eggs in one, and leaves to the working bees the task of subsequently arranging them. The eggs laid at the commencement of fine weather all belong to the working sort, and hatch at the end of 4 days. The larvae are regularly fed by the workers for 6 or 7 days, when they are enclosed in their cell, spin a cocoon, and become nymphs, and in about 12 days acquire their perfect state. The cells are then immediately fitted up for the reception of new eggs. The eggs for producing males are laid two months later, and those for the females immediately afterwards. This succession of generations forms so many particular communities, which, when increased beyond a certain degree, leave the parent hive to found a new colony elsewhere. Three or four swarms sometimes leave a hive in a season. A good swarm is said to weigh at least 6 or 8 pounds. The life of the bee, like that of all the other insects of its class, does not continue long after the great business of providing for the continuance of the species is completed.

The honey-bee is frequent in the wild state in warmer climates, but is very rarely to be found in Britain; nevertheless it is said to exist, and that a hive was discovered within these some years. Thus the animal may have either been domesticated at a very remote period by the inhabitants, or it may have been brought from abroad. Naturalists doubt whether the wild honey-bee is a native of America, though existing in numbers in the woods. It is rather supposed to have been carried thither in the sixteenth or seventeenth century. Honey is said to be a great article of subsistence in Madagascar, and in other places where bees are common in the clefts of trees. In Africa there is a small bird called *cuculus indicator*, or the honey-bird, which, uttering a peculiar note, and flitting from bough to bough, will infallibly lead the traveller to a swarm in some hollow of a tree.—See *Swammerdam Biblia Naturæ*.—*Maraldi sur les Abeilles*, *Mem. de l'Académie des Sciences*, 1712.—*Reaumur, Memoires pour servir a l'Histoire des Insectes*, tom. v.—*Schirach, Histoire Naturelle de la Reine des Abeilles*.—*Bergman, De Apibus et Mellificii vicissitudinibus ex Alveorum ponderatione æstimandis*.—*Ray, Memoire sur l'Histoire des Abeilles, Journal de Physique*, tom. xxiv.—*Bonnet, Œuvres*, tom. v.—*Della Rocca, Traité complet sur les Abeilles*.—*Butler's Feminine Monarchy*.—*Hartlib's Commonwealth of Bees*.—*Thorley's Inquiry into the Nature, Order, and Government of Bees*.—*Wildman on the Management of Bees*.—*Bromwich's Experienced Bee-keeper*.—*Bonner's New plan for speedily increasing the number of Bee-Hives in Scotland*.—*Huber's New Observations on the Natural History of Bees*.—*Cotton's Bee Book*.

The indistinct descriptions which some travellers give of the bees of different foreign countries, render it difficult for us to determine whether the real honey-bee is meant or not. It

is true, they describe such bees as being the same; but they maintain, that one species wants a sting, and that another nestles in the earth with its honey. So far as naturalists have yet ascertained, neither of these peculiarities belong to the honey-bee; but it is extremely probable, that besides the single species which we keep in hives, others might be domesticated. One kind is found in Surinam, which hives in very numerous societies. These construct a nest eight or ten inches in diameter, and eighteen or twenty long, towards the top of trees of moderate height. Within are found large cells of a fine reddish liquid honey, in great abundance. The nests, which resemble a lump of earth applied against the tree, cannot be procured unless the tree be cut down, when the natives of the country, after using the honey, and making a kind of mead, roll the wax around matches.

Honey.—All the operative parts of the economy of the hive are intrusted to the workers; and as the collection of honey and combs which they construct are the substances converted to our use, and indeed is the main purpose of our cultivating them in numbers, it is proper that we should elucidate the manner in which this is effected. Honey is a vegetable secretion, which appears at different seasons of the year, especially when flowers in general blow. We can readily understand how it is stored up by the bees: they lick it with the proboscis from the flowers; it is swallowed; and on their return to the hive it is disgorged, not from the trunk, but the mouth, into the cells. Only a small portion is collected by each, but the united labours of thousands produce an abundant harvest. Reaumur has calculated, that within an hour 3,000 bees have returned from their collections to a hive, whose population did not exceed 18,000; and in six days, Swammerdam, if we rightly understand his expressions, found nearly 4,000 cells constructed by a new swarm, consisting of less than 6,000 bees. Some of the cells filled with honey are destined for the daily consumption of the bees, and others are sealed up and reserved for times of necessity. Many of the labourers free themselves of their collections before reaching the cells, by bestowing them on their neighbours; the trunks of the latter are seen extended, and they receive the honey with them as it is disgorged. Honey being a vegetable product, its properties depend entirely on the nature of the plants from which it is collected: one kind is of the finest flavour, delicious to the taste, pure and transparent; another is entirely of a different consistence, dark, greenish, tenacious or bitter; and a third kind has been known to produce deleterious effects, which were almost, if not completely, fatal to human life. Dioscorides, Pliny, and various ancient authors, speak of honey in the east being dangerous in certain years; and Xenophon relates, that when the army of ten thousand approached Trebisonde, the soldiers having partaken copiously of honey found in the neighbourhood, were affected like persons inebriated; several, on whom it had more violent consequences, became furious, and seemed as if in the agonies of death. Though none of them died, all were extremely weak for three days. In recent times, we are told of the pernicious effects of a particular kind of honey collected in America; and plants grow in the Archipelago, the honey of which is said to occasion vomiting. Thus Don Felix Azara informs us, that there is a particular kind of honey collected in Paraguay, called *cabatatu*, which occasions a severe headach, and produces as perfect intoxication as ensues from brandy; while another kind brings on

convulsions, attended with the most excruciating pains, which last thirty hours.

Wax.—Bees are seen laden with a yellowish substance in very considerable quantities, which also is stored up in the hive. This is not wax, as is commonly supposed, but either the pollen of flowers, which is used for feeding their young, or propolis for stopping the crevices of their dwelling. The combs are constructed of wax, which owes its origin to honey: or it may be formed from sugar, the saccharine part of which constitutes one principal ingredient of honey. Naturalists have adopted many conjectures concerning the mode in which it is elaborated by the bees. In general they supposed that the yellowish pellets adhering to their limbs were swallowed, and afterwards disgorged as wax in a state of purity. The process is still obscure, but recent experiments seem to afford reason for believing that it may transude between the scales of the abdomen; and the appearance presented by wax on such places led former observers to affirm, that it was collected there instead of on the limbs. It is established by satisfactory experiments, that, whatever be its issue from the body of the bee, it originates from honey. Mutual relations subsist in their elementary principles, and the one is dependent on the other. Those years unproductive of honey are also unproductive of wax; and we often see swarms which begin their collections with the most promising appearance, still make but little progress, and terminate with acquiring too small a quantity of honey for their future subsistence. In these cases, wax is sparingly provided also.

Repeated observations prove, that the secretion of honey in flowers is powerfully promoted by the electricity of the atmosphere; and bees never labour more actively than during humid sultry weather, and when a storm is approaching. Sometimes the secretion of honey is entirely suspended by the state of the weather, which occasions a total interruption of the labours of the bees; and if this be too long protracted, a populous hive may actually die in the midst of summer. The odour exhaled by the hives, and the size of the bees, are always certain indications whether the flowers contain honey. When numbers of bees return from their excursions with the belly thick and cylindrical, it shows they are gorged with honey; and these are exclusively the workers in wax. The belly of those performing the other functions, always preserves its ovoidal form, and does not sensibly increase in size. Although the flowers be destitute of honey, bees still are able to store up quantities of farina or pollen necessary for feeding their young.

Use of the Propolis.—The propolis is another substance collected from plants, which is extremely useful to bees. Besides the purposes of stopping crevices, covering the interior surface of the hive, the sticks supporting the combs, and gluing the hive to the board on which it stands, bees employ it in greater portions at once. Stranger animals of small size entering a hive are immediately stung to death, and then dragged by the bees to the outside: there are few persons who have not seen that a dead fly, or bee laid on their board, is quickly carried away and dropped at a distance: it seems the nature of these insects not to endure any filth or corruption in their habitation. Should a larger animal, such as a snail, make its way into the hive, it does not escape; it is put to death, but the bees are unable to divest themselves of its body. Maraldi relates, that he saw the dead body of a snail totally covered with propolis, and thus prevented from spreading infection in the hive; and Reaumur tells us, that a shell snail having fixed itself on the pane of a glass hive, waiting until the moistness of weather should be an inducement for it to move, the bees encircled the mouth of the shell with so thick a bed of propolis, that the animal,

unable to moisten it as it moistens its own gluten, was arrested on the spot. The original source of the propolis is not yet perfectly understood: it is much more tenacious, and attains a greater degree of hardness than wax: those bees that return laden with it, owing to its tenacity, experience considerable difficulty, even with the aid of their companions, in divesting themselves of the load. M. Ducarne observes, "Several times I have seen bees occupied in collecting, or rather in tearing away with their teeth, the propolis of old hives which I had exposed to the sun; and this appeared so laborious, and the animals pulled so forcibly, that I thought their heads would have been separated from their bodies."

Swarming.—Though the hive be amply stored with honey and wax, and the young brood gradually approaching to maturity, seems to leave nothing to be desired by the bees, they all of a sudden desert their habitation to go in quest of another. For this incident, which is called *swarming*, there is no ostensible cause, nor do the reasons assigned for it by different observers prove satisfactory in our estimation; for its occurrence is irregular, and its frequency is uncertain. According to common apprehension, swarming ensues from a hive being overstocked with bees, and especially from a young queen seeking a new dwelling. It never takes place, we acknowledge, unless the bees be numerous; but there are so many exceptions, that we cannot say it is from wanting room: and instead of the young queen, it is always the old one that leads out the swarm: nay, should an old queen have conducted a swarm of this year, she will also be found at the head of the first which next year leaves the hive. Each subsequent colony departing is led by a young queen. An old queen never leaves her hive until she has deposited eggs which will become future queens, nor until her principal laying of the eggs producing drones is over; the common bees construct royal cells only, while she lays those eggs which will be transformed to drones; and after this laying terminates, her belly being more slender, she is better able to fly; whereas it is previously so heavy and surcharged with eggs, that she can hardly drag herself along. One chief cause or concomitant of swarming apparently consists in the agitation of the queen. She is suddenly affected, hastily traverses the combs, abandoning that slow and steady progression which she ordinarily exhibits: her agitation is communicated to the bees; they crowd to the outlets of the hive, and the queen escaping first, they hasten to follow her. Commonly the whole take but a short flight, and the queen having alighted, the bees cluster around her. This constitutes the new swarm. With regard to the precursors of swarming, there is no infallible guide: those on which observers are accustomed to rely, the most frequently prove fallacious. The general indications given by Reaumur—a naturalist of the first eminence, who draws his conclusions from facts, and has fallen into few errors—are, first, the appearance of drones in a hive; for no swarm will proceed from one where

there are none: secondly, when the bees are so numerous, that part crowd about the outside of the hive, or lodge on the board in clusters of thousands: and thirdly, which is the least equivocal sign of the day of swarming, when fewer bees than usual go abroad for collection, and return without honey or wax. Most observers also affirm, that in the evening before swarming an uncommon humming or buzzing is heard in the hive, and a distinct sound from the queen, called *tolling* or *calling*. Mr. Hunter compares it to a note of a pianoforte; and other authors to different tones.

The extraordinary instinct and precautions so conspicuous in bees, are apparently affected during the period of swarming. We cannot admit, with those observers, who seem more actuated by the love of the marvellous than an exposure of truth, that they are endowed with that prescience which induces them, before their departure, to prepare a place for their reception. On issuing from the hive, bees, so nearly as we can determine, have no object in view; and they often resort to situations the most unlikely, and evidently unsuitable for their convenience or preservation. After rising in the air, it is commonly some tree that arrests their progress, and the queen frequently alights at the unsheltered extremity of a branch, where the bees that may have formed into various clusters in the vicinity, come to surround her. But we have known them repeatedly swarm on the grass, near the hive they had forsaken, notwithstanding trees were at no great distance. Bees swarm only during the best weather, and in the finest part of the day. Sometimes all the precursors of swarming, disorder and agitation, have been seen; but a cloud passed before the sun, and tranquillity was restored. If a hive swarms oftener than once, the new swarms consist of those bees that have been abroad when the first event took place, added to young ones come from the eggs, laid by the queen before her departure. Each is led out by a young queen, as there are usually several royal cells in a hive: but the bees can prevent the whole queens nearly of an equal age from leaving their cells, though come to maturity: and when they do liberate them, it is according to their age, which they have some secret means of ascertaining; for the oldest are invariably liberated first. The young swarm, whether removed from the place where it settles or not, begins to work; cells are constructed of wax from the honey the bees have carried along with them; and nature has so arranged it, that the first eggs laid by the queen produce the operative part of the community.

Different kinds of hives.—All the circumstances above related having taken place, the new swarm is lodged in a hive, there to commence the collection of honey, the fabrication of wax, and the perpetuation of the species. Much has been said of the fittest size and figure of a hive, and of the substance of which it should consist: wood, straw, and oziers, have all been recommended; and round, square, ob-

long, and hexagonal hives have had their particular partisans. These things, we apprehend, do not merit the importance bestowed upon them; and our reason for saying so is, from having seen the most ample products of honey, under conditions almost diametrically opposite. At one time we have seen large straw hives, of the ordinary fashion in this country, full to the brim of rich honey comb; at other times we have seen them almost empty, without any sensible cause, and where circumstances seemed to favour the reverse. We are thence induced to conclude, that less depends on the shape and capacity of the hive, than on the kind and quantity of the swarm introduced into it, and on the season in which their collections are made. Examples have come under our notice, where a swarm, lodging in the roof of a house, has produced a great quantity of honey in combs only four or five inches broad: another swarm also in the roof of a house, we have known to fill combs above eighteen inches in breadth. Exposure to the north or south has not affected the bees: their provision has been equally abundant. And here we may remark, that in all instances that have fallen within the sphere of our observation, the products of swarms, lodged in the roofs of houses, have invariably been abundant. We do not pretend to account for this. Perhaps it may partly result from their labours being performed without any disturbance or interruption; partly from the greater heat preserved in a roof during summer. Heat is the soul of insects: their action and exertion are directly in proportion to the temperature of the atmosphere; and cold is the bane of their existence. It is not unlikely, also, that the same cause promoting the hatching of the brood, contributes to render the colony more numerous: and if their swarming is at all dependent on want of room, large portions of them have not an equal inducement to seek another dwelling. Pallas tells us, that the Russian peasants, in remote parts of the empire, hollow out a part of the trunks of trees, 25 or 30 feet from the surface of the earth, for the purpose of hives; and cover the opening with planks, having small apertures for the bees. At Cazan, Mr. Bell saw hives of a similar form, which the inhabitants bound to the trees at the side of a wood, in order to secure them from the bears. As abundant collections of honey are often made in the common straw hives, we cannot affirm that they are unsuitable for the purpose; but they are attended with the disadvantage of preventing the owner from an early appropriation of the labours of the bees. One convenience, indeed, lies in the facility of construction, which always merits due appreciation in every branch of rural economy; and, also, that the cost is inconsiderable. Though neither the size nor figure of the hive be important, all modern cultivators seem agreed that it should be susceptible of additions. In the ordinary straw hive, the addition is made by raising it on a circular ring or hoop, either of wood or of the same materials; a clumsy and awkward expedient, which commonly leads the bees to waste much of their labour in filling up crevices. Notwithstanding this, it is adopted in Brittany with some little difference, and there called the *Scotch hive*. The hive itself consists of two pieces, each twelve inches wide, and eleven high, made of rolls of straw. The under one is divided from the other; but a communication-hole, fifteen or eighteen lines in diameter, is left for the bees. As they work downwards, the under part, which is nothing but one of our common *ceks*, or broad hoops, is next filled.—Pyramidal hives have been made several feet in height, and divided into different stages or compartments; which the bees, after being lodged in the highest, would successively fill on removal of the floors or stages.—Boxes of convenient size and form, placed above each other, have likewise been recommended, and which we should

suppose well adapted for enabling the cultivator, at all times, to take the honey with ease. Such boxes are made of well seasoned wood, nine inches long, the same in breadth, and eight inches high; but from what we have said, there is no necessity for a rigid adherence to these dimensions. In the roof there is a communication-hole three inches square, on which is placed another box of similar structure; others may be raised above this to an indefinite height; and the bottom of each is open like the mouth of a common hive. When a swarm is lodged in a box, if only two be used, it is immediately to be put over an empty one, as the bees must have more room; and if more than two are used, a new one is successively to be supplied below. The bees, beginning from above, will soon fill the upper box with honey; and it is then to be separated from that beneath it, by drawing through a long thin pliable knife to cut the comb. The communication-hole of the lower box must then be covered with a board, and the box separated carried to a distance, where the bees remaining in it may be dislodged, by turning it up, and rapping on its sides with a small stick. The proper time to perform this operation is at sunrise.—Collateral boxes have also been suggested, from the belief of their being attended with greater advantages to the bees. The size is nearly the same with that above mentioned. There is a communication-hole in the side, and an opening low and wide below in the sides applied to each other, to allow the bees more ready passage. Collateral hoops of twisted straw or wood were long ago invented, by which means the inventor enlarged his hives to an unlimited extent; and these he kept, with great advantage, in a garret near the roof of his house.

Those who are anxious to view the various and progressive operations of bees, may gratify themselves, by procuring hives with glass sides. This can hardly be denominated a modern invention, as Pliny records, that a Roman senator had something of the same kind, made of the thinnest and most transparent horn. But those entirely made of glass were not known on the continent before the year 1680, though they were made with panes in England earlier in the same century; and hives made completely of glass are spoken of in 1655. Glass hives ought not to be round, like the common shape, as the bees are concealed among the combs; they should be square boxes, whose sides consist of four panes. Reaumur used them so thin as to admit of no more than two combs being constructed, that he might the better witness the procedure of the inhabitants. A pane on each side of Huber's hollow frames exposes both sides of the comb. Such hives must be covered with a wooden box, or an opaque substance, as light disturbs the operations of bees.

Site of the Apiary.—The situation and arrangement of the apiary claim the cultivator's attention. Each hive should stand on a wooden sole, or rest, supported on a single wooden post driven into the ground, or on three close together, near the centre of the board, that the enemies of the colony may have difficulty in crawling up from below. It should be fixed securely, so as to escape being overturned by the wind; but the common custom of laying a turf on the top must be avoided, on account of the harbour it affords to noxious insects. Hives should stand far apart; if there are six hives in one portion or division of the apiary, they should not be less than nine or twelve feet asunder. But too great a number never should be situated in the same district. The collections of bees are drawn solely from

flowers, and perhaps, in some small measure, from honey-dew, which at times appears on leaves, and is said to produce an inferior honey; it is therefore evident, that immense quantities of bees, actively employed, would not be long of exhausting the whole. The number of hives should, therefore, be regulated by the situation of the apiary. A district abounding with flowers and blossoms will admit of more than one where the chief product is grain. An apiary ought to stand in a quiet sheltered place, where the bees may perform their labours totally undisturbed; flowers, particularly those most fruitful in honey, should be copiously disseminated around; and, for the facility of saving swarms, it is better to have low flowering shrubs in the vicinity than lofty trees. Means should be practised to obtain a succession of flowers in successive seasons, that the bees may always have the collection of honey in their power, and without going to a distance. It is not known how far they fly: some think they traverse several miles; others, that their flight hardly exceeds half a league: but the accidents to which they are exposed render it important for provisions to be near at hand. In the low country, mignonette is said to afford the finest honey, and may be kept in blossom a large portion of the year. Bromwich, an intelligent writer, relates that, in 1779, he planted a great quantity of it before two bee hives, at a considerable distance from any other bees. With such abundant supplies as this afforded them, few ever left his garden. In September he took the honey, and found it exceed, by above a third, what he obtained from any other two of his best hives, where the bees were obliged to fly farther, and equal in fragrance and colour to what is imported from the warmer climates. It is a favourite flower among bees; for we have observed patches of it, in the very centre of the city of Edinburgh, resorted to from hives beyond the suburbs. Bonner affirms, that he has often "seen a hive, by being placed nigh heath, become ten, twelve, or fifteen pounds heavier in the month of August; whereas, if it had remained in its original early situation, it would probably have become every day lighter after Lammas."

Feeding Bees.—When seasons are peculiarly unfavourable for the secretion of honey, sometimes, we have said, a whole swarm may perish in the middle of summer. Then, or when they are deprived of too great a portion of their stores, it becomes the cultivator's care to supply the deficiency. There are various methods of doing so, always regulating the supply by the number of bees and the temperature of the atmosphere. The hive may be placed above a section of another hive containing several combs with honey; or combs may be laid on the boards of the hive before the entrance, which is less to be recommended from exposing the bees and their provisions to the invasion of strangers. Syrup of sugar, treacle, and other sweet substances, may

be given them as food, introducing their allowance every afternoon in nutshells, or in a vessel with a grated covering, by an opening in the back of the hive. Unless the supply be daily administered, it is extremely difficult to preserve the bees; and by admitting of longer intervals, the most skilful cultivators have failed. A practical operator informs us, that he takes an oblong box, in one end of which is a reservoir containing honey, that is allowed to flow from the bottom of the reservoir under a thin float buoyed up by cork. This float has many small perforations, through which the bees standing on it supply themselves with the honey. There is one hole in the side of the box, which is to be applied to the entrance of the hive, for admitting the bees above the float, and another on the opposite side, which is opened at pleasure, to allow them to escape, should the box be too much crowded. The lid of the box is a glass pane. On pouring honey into the reservoir, the float rises, whence there should not be such a quantity as to raise it close to the lid or pane above. The box is about ten inches long, four broad, two and a half deep, and the reservoir is an inch wide. When used, the hole in the side is to be placed close to the entrance of the hive, which must be gently rapped on if the bees do not immediately find the way down. It is entertaining to observe bees accustomed to be fed in this manner, watching the approach of the feeder; when the ordinary time draws near, they rush down to the box the moment that it is put on the board, and after speedily filling themselves they return to the hive, from which they very soon come back for a second supply. By throwing a little fine flour on those leaving the box, it will be seen that they can fill themselves in three minutes, and are absent not above five. One convenience that attends feeding in such a box, is the exclusion of stranger bees; as the sole communication with the interior is from the entrance of the hive. Several practical operators recommend a mixture of sugar and small beer as food, which we should warn others to be cautious of adopting, as they will find honey or syrup quite adequate to their purpose. It is maintained that fruit may likewise be presented to bees for feeding them.

Mode of taking the honey and wax.—It is ungrateful to reflect, that, after all our care in watching the progress of bees, in screening them from injury, added to our admiration of their singular industry, we must at once sacrifice so many thousand lives in order to come at their stores. Yet such is the general, though pernicious practice; and whole colonies, which, in another year, would send forth tens of thousands equally industrious as themselves, are utterly extirpated. The mode of doing so is well known. When the hives cease to increase in weight, or, rather, when they begin to grow lighter, a hole is dug in the ground, and some rags dipped in melted brimstone being inserted in the clefts of

twigs stuck into the earth, the matches are kindled, and, putting the hive above them, the bees are quickly suffocated, and fall down in a heap. Some authors strenuously defend this practice, contending, that all expedients to save the bees are both difficult and precarious, and that they do not produce the same advantages. We conceive that its facility, combined with inveterate adherence to established customs, has proved a strong recommendation. But the majority of modern cultivators are disposed to preserve the bees, while they share their collections. Towards the end of September, when all the flowers have faded, when there is little brood in the combs, and the bees are beginning to consume the honey they have laid up, they may be frightened out of the hive by beating on it, and the combs then safely taken away. This, however, would reduce the owner to the necessity of feeding them during winter, whence an earlier season is generally chosen for it, that the bees may still have time to lay in winter provender. The highest part of a hive being always filled first, and with honey of the finest quality, it may be taken in the midst of summer if the bees are kept in boxes, simply by removing the upper one, and substituting another below, if that be required. As every comb is seen in the leaf hive, any one of the whole can be removed at will, and new divisions inserted. The stores of the bees should be moderately partitioned with them, and due regard always paid to the advancement of the season, and the state of the atmosphere. We cannot tell how much they will produce. Tholey declares that, in some summers, he has taken two boxes from one hive, each containing thirty pounds of honey. We hear of hives weighing seventy, eighty, or even an hundred pounds; but these bear no comparison with what M. Duhamel relates. A clergyman in France, who had placed a well-stocked hive over an inverted tub with a hole in the bottom, obtained no less than 420 pounds of honey and six of wax from it. The cultivator should know the exact weight of his hives, and mark their gradual increase or diminution, which will enable him to ascertain the proper time of taking the honey. Bonner judiciously observes, that "the harvest of honey, like that of corn, is earlier or later, more plentiful or scarce in different years, according to the weather and the climate, and the variety of the seasons and situations." Sometimes he has known a hive become gradually lighter after the first week of August; at other times, in favourable weather, hives situated near heath have continued working actively during the whole of August, and the greater part of September, and daily become heavier.

Separation of honey and wax.—Of the practical separation of honey and wax we need say little, as it is universally understood by those who cultivate bees for profit. That honey which is most fluid, and runs most easily from the comb, is con-

sidered the best and finest. To promote the separation of the rest, the combs should be cut into very small portions, and exposed before a fire, to render the honey more liquid; the product will be honey of the second degree of fineness; and the remainder should be heated still more in a vessel over a fire, and then squeezed through a canvass bag, which will produce a coarser kind, well adapted for feeding bees. It facilitates the operation, to erect a stage of three or four sieves, one always finer than the other from the top, and in a short time the separation is effected. Honey comb, wrapped in paper, and kept in a cool place, may be preserved entire during a whole winter or longer. To purify the wax, nothing more is necessary than boiling the empty combs, and those deprived of the honey, in water, and removing the scum which will rise in the successive meltings. The Abbe della Rocca proposes to put a quantity of comb, tied up in a linen or woollen bag, into a cauldron of water; as the heat increases, the wax liquefies, and, escaping through the interstices of the bag, rises to the surface, while the refuse is retained behind. This is a simple, and, as we conceive, very effectual method.

We apprehend that very few precautions are necessary for preserving bees in winter. They are not torpid in that season provided they be numerous, and then they cluster together towards the top of the hive. But, like other insects, they are liable to torpidity when single, or where there are few collected together, and that torpidity, by an extraordinary increase of cold, will end in death. With the view of saving their provision, it has been proposed to keep bees torpid, or in an ice-house all winter. It is undoubted that in a certain degree of cold they cease to consume honey, and animals may live an indefinite time in a state of torpidity. The hives ought not to be exposed to sunshine in the depth of winter, for the bees are induced to go out, and the sudden cold that follows deprives them of the power of returning.

The cultivation of bees forms one considerable branch of rural economy, and we could wish to see it much farther extended. This country is capable of supporting at least four or five times the number of hives now kept in it; and, without indulging in the speculations of extravagant profit, which are generally entertained by the authors who write on the subject, we will confidently affirm, that every one who attempts keeping bees on a moderate scale, and pays them some attention, will find it advantageous.

The Humble bee.—There is a species of bee which collects the honey of plants, and stores it up in cells, though we may doubt if this is intended for its winter-provision. This is called the *humming* or *humble bee*, an insect so common in Britain as to have attracted the attention of every one. Like the honey-bee, it lives in societies, consisting of from 20 to 100 males, females, and what

are supposed neuters. We have never found the society more numerous in Scotland, and the continental authors seem to describe it as smaller. These societies either dwell in cavities of the earth, or in tufts of moss collected together on the surface; or sometimes those whose proper habitation is in such cavities, are content with a hollow of the ground, where they cover themselves with moss and bits of leaves; or we have seen them effect a lodgement in a wooden box, some feet above the ground, in which they appeared to have themselves collected moss and leaves, and there bred a considerable colony. In reverting to the origin of these societies, we are opposed by very considerable difficulties. It seems probable, that a single female, which has been accidentally preserved through the winter, is the parent of the whole, and that she selects the spot, or cavity, for her posterity. No naturalist has, we believe, yet beheld a nest in its origin, though it has been seen when consisting of few cells. Reaumur relates, that on one occasion he removed the whole combs from a nest, and completely evacuated the interior. Nothing was visible for several days; but after the bees had remained eight days undisturbed, a lump of paste and farina the size of a nut was found in it, attached to which was a pot of honey, that is, a half-made cell, which the bees at times construct, and in which some of their honey is kept. Thence, and from other circumstances, it is conjectured, that the mother proceeds to collect a quantity of farina or pollen, in the midst of which her eggs are laid; and by their coming to maturity after a certain time, the colony is constituted and enlarged. Several females inhabit the same nest, living in harmony together. They are occupied in collecting honey; and are easily known, from being the largest of all the three species. The males are next in size; always of a lighter colour; and are capable of making wax. The workers are of various sizes in the same nest, some not being half the size of others. Nature does not require the like sacrifice in the males of humble bees as in those of the honey-bee to propagate the species; the sexual union takes place according to the common mode of insects; neither is there any massacre among them. Females and workers are much less disposed to use their stings than the honey-bee; here, also, the males have none.

On opening a nest containing a colony of humble bees, a confused and misshapen aggregate of ovoidal substances is disclosed, interspersed in various parts with crude masses of wax, and cells of honey. The ovoidal substances are the young coming to maturity, within a silken cocoon coated with wax; and amidst some of the lumps of wax are found larvæ, which one author thinks are there for the purpose of being fed, and another for being preserved from cold and humidity. The eggs are deposited in cells, which the workers lend their aid to construct; and the mother her-

self completes them, smoothing and polishing the interior. When she prepares to lay in a cell, the workers, unlike that care which those of common bees bestow on the eggs of their queen that are to preserve the colony, eagerly endeavour to devour them. The moment that the eggs are deposited, and the female is about to close the cell with a waxen covering, they rush upon it, and are repulsed only by her defence; or, if she removes during an instant, they steal thither, and surreptitiously carry off the eggs. The female is, therefore, under the necessity of keeping incessant watch during several hours, after which she may leave the cell; for it is only in their first stage that the eggs are sought for with avidity by the common bees. Sometimes twenty eggs are deposited by a female in a single cell, which is then closed; but it does not appear that the bees are careful to provide the young with a sufficient store to serve them until their ultimate metamorphosis; for the mother supplies a thick layer of pollen whereon her eggs are deposited, which is soon consumed by the larvæ. After being hatched, the common bees make a small hole in the top of the cell, and then go in quest of honey or pollen. This they obtain from the rest of their combs, and seem to introduce it by the opening to feed the young; they then withdraw, and close the cell. Some cells acquire perceptible increment; from being very small they become as large as a nut, which results from the included worms, perhaps six or seven in number, successively bursting the cell, and the cleft being as often covered over with wax by the bees. When the young bee has attained its perfect state, the workers gradually contract the mouth of the cell it has left, and lay up their honey in it. Other cells are also constructed of pure wax, which are so many reservoirs of honey from the beginning, and have never contained young.

Humble bees form a very considerable quantity of wax; and the observations of naturalists regarding them has thrown some light on the production of this substance. Several species, both of those that dwell in cavities of the earth, and those that inhabit nests covered with moss on the surface, invest their whole combs with a waxen envelope, so as to serve for a protection. It rises around their combs like a kind of wall, and constitutes both a floor and a roof, at such distance from the cells as to admit of the bees passing. When their envelope is destroyed, the bees restore it with wonderful assiduity. An observer, by removing it four times in nine days, obtained as many new coverings, which formed eight inches square; and in four or five days more they made a new one, which, along with the others, weighed 365 grains. Instead of this covering, however, they are frequently obliged to be content with moss or leaves. Females produce a greater quantity of wax than any of the other individuals in a nest; but the males produce it also, though they cannot, like the females

and workers, convert it to use. The wax of humble bees is an immediate production from the honey on which they feed.

Humble bees are remarkably subject to torpidity, and perhaps might be the means of illustrating the difficulties attending all investigations into its operation on insects. Towards the end of autumn they are seen languid and inactive on the few remaining flowers, incapable of defending themselves from injury. The life of the whole apparently terminates with the season, unless it be from some accidental circumstance, as we have already observed, that a few of the females are preserved. How they survive the winter we know not; possibly it may be in the earth, or in the holes of walls; but the number must be very small. Were they not in torpidity they would fly about during the winter, which is never seen; and the same degree of heat would awaken the whole, or there would be no considerable difference, unless by their being farther withdrawn from the influence of the atmosphere. Very few, however, appear in spring; and it is not until the heats of summer, or rather later, that they become numerous. The casualties to which these and many insects are exposed, render it far from improbable, that various species gradually become extinct.

The Carpenter-bee.—Besides the bees already mentioned, there are various kinds that have much the appearance of honey-makers, and yet make only wax. The wood-bee is seen in every garden. It is rather larger than the common queen-bee; its body of a bluish black, which is smooth and shining. It begins to appear at the approach of spring, and is seen flying near walls exposed to a sunny aspect. This bee makes its nest in some piece of wood, which it contrives to scoop and hollow for its purpose. "We have frequently witnessed," says Mr. Rennie, "the operations of these ingenious little workers, who are particularly partial to posts, palings, and the wood-work of houses which has become soft by beginning to decay. Wood actually decayed, or affected by dry-rot, they seem to reject as unfit for their purposes; but they make no objections to any hole previously drilled, provided it be not too large; and, like the mason-bees, they not unfrequently take possession of an old nest, a few repairs being all that in this case is necessary. When a new nest is to be constructed, the bee proceeds to chisel sufficient space for it out of the wood with her jaws. We say *her*, because the task in this instance, as in most others of solitary bees and wasps, devolves solely upon the female, the male taking no concern in the affair, and probably being altogether ignorant that such a work is going forward. It is at least certain the male is never seen giving his assistance, and he seldom if ever approaches the neighbourhood. The female carpenter-bee has a task to perform no less arduous than the mason-bee; for though the wood may be tolerably soft, she can only cut

out a very small portion at a time. The successive portions which she gnaws off may be readily ascertained by an observer, as she carries them away from the place. In giving the history of a mason-wasp, we remarked the care with which she carried to a distance little fragments of brick, which she detached in the progress of excavation. We have recently watched a precisely similar procedure in the instance of a carpenter-bee forming a cell in a wooden post. The only difference was, that the bee did not fly so far away with her fragments of wood as the wasp did; but she varied the direction of her flight every time; and we could observe, that after dropping the chip of wood which she had carried off, she did not return in a direct line to her nest, but made a circuit of some extent before wheeling round to go back. On observing the proceedings of this carpenter-bee next day, we found her coming in with balls of pollen on her thighs; and on tracing her from the nest into the adjacent garden, we saw her visiting every flower which was likely to yield her a supply of pollen for her future progeny. This was not all: we subsequently saw her taking the direction of a clay-quarry frequented by the mason-bees, where we recognised her loading herself with a pellet of clay, and carrying it into her cell in the wooden post. We observed her alternating this labour for several days, at one time carrying clay, and at another pollen; till at length she completed her task, and closed the entrance with a barricado of clay, to prevent the intrusion of any insectivorous depredator, who might make prey of her young; or of some prying parasite, who might introduce its own eggs into the nest she had taken so much trouble to construct. Some days after it was finished, we cut into the post, and exposed this nest to view. It consisted of six cells of a somewhat square shape, the wood forming the lateral walls; and each was separated from the one adjacent by a partition of clay, of the thickness of a playing card. The wood was not lined with any extraneous substance, but was worked as smooth as if it had been chiselled by a joiner. There were five cells, arranged in a very singular manner—two being almost horizontal, two perpendicular, and one oblique. The depth to which the wood was excavated, in this instance, was considerably less than what we have observed in other species which dig perpendicular galleries several inches deep in posts and garden-seats; and they are inferior in ingenuity to the carpentry of a bee described by Reaumur, which has not been ascertained to be a native of Britain, though a single indigenous species of the genus has been doubtfully mentioned, and is figured, by Kirby, in his valuable 'Monographia.' If it ever be found here, its large size and beautiful violet-coloured wings will render mistakes impossible.

"The violet carpenter-bee usually selects an upright piece of wood, into which she bores

obliquely for about an inch; and then, changing the direction, works perpendicularly, and parallel to the sides of the wood, for twelve or fifteen inches, and half an inch in breadth. Sometimes the bee is contented with one or two of these excavations; at other times, when the wood is adapted to it, she scoops out three or four—a task which sometimes requires several weeks of incessant labour. The tunnel in the wood, however, is only one part of the work; for the little architect has afterwards to divide the whole into cells, somewhat less than an inch in depth. It is necessary, for the proper growth of her progeny, that each should be separated from the other, and be provided with adequate food. She knows, most exactly, the quantity of food which each grub will require, during its growth; and she therefore does not hesitate to cut it off from any additional supply. In constructing her cells, she does not employ clay, like the bee which we have mentioned above, but the sawdust, if we may call it so, which she has collected in gnawing out the gallery. It would not, therefore, have suited her design to scatter this about, as our carpenter-bee did. The violet-bee, on the contrary, collects her gnawings into a little store-heap for future use, at a short distance from her nest. She proceeds thus:—At the bottom of her excavation she deposits an egg, and over it fills a space nearly an inch high with the pollen of flowers, made into a paste with honey. She then covers this over with a ceiling composed of cemented sawdust, which also serves for the floor of the next chamber above it. For this purpose, she cements round the wall a ring of wood chips, taken from her store-heap; and within this ring forms another, gradually contracting the diameter till she has constructed a circular plate, about the thickness of a crown-piece, and of considerable hardness. This plate of course exhibits concentric circles, somewhat similar to the annual circles in the cross section of a tree. In the same manner she proceeds till she has completed ten or twelve cells; and then she closes the main entrance with a barrier of similar materials. Let us compare the progress of this little joiner with a human artisan—one who has been long practised in his trade, and has the most perfect and complicated tools for his assistance. The bee has learned nothing by practice; she makes her nest but once in her life, but it is then as complete and finished as if she had made a thousand. She has no pattern before her—but the Architect of all things has impressed a plan upon her own mind, which she can realize without scale or compasses. Her two sharp teeth are the only tools with which she is provided for her laborious work; and yet she bores a tunnel, twelve times the length of her own body, with greater ease than the workman who bores into the earth for water, with his apparatus of augers adapted to every soil. Her tunnel is clean and regular; she leaves no chips at the bottom, for

she is provident of her materials. Further, she has an exquisite piece of joinery to perform, when her ruder labour is accomplished. The patient bee works her rings from the circumference to the centre, and she produces a shelf, united with such care with her natural glue, that a number of fragments are as solid as one piece. The violet carpenter-bee, as may be expected, occupies several weeks in these complicated labours; and during that period she is gradually depositing her eggs, each of which is successively to become a grub, a pupa, and a perfect bee. It is obvious, therefore, as she does not lay all her eggs in the same place—as each is separated from the other by a laborious process—that the egg which is first laid will be the earliest hatched; and that the first perfect insect, being older than its fellows in the same tunnel, will strive to make its escape sooner, and so on of the rest. The careful mother provides for this contingency. She makes a lateral opening at the bottom of the cells; for the teeth of the young bees would not be strong enough to pierce the outer wood, though they can remove the cemented rings of sawdust in the interior. Reaumur observed these holes, in several cases; and he further noticed another external opening opposite to the middle cell, which he supposed was formed, in the first instance, to shorten the distance for the removal of the fragments of wood in the lower half of the building."

The Poppy-bee.—A species of the leaf-cutting, or upholsterer bee, is called the *poppy-bee*, from its selecting the scarlet petals of the poppy as tapestry for its cells. Kirby and Spence express their doubts whether it is indigenous to the country; but Mr. Rennie is almost certain that he saw the nests in Scotland. "At Largs, in Ayrshire," he says, "a beautiful sea-bathing village on the Firth of Clyde, in July, 1814, we found in a foot-path a great number of the cylindrical perforations of the poppy-bee. Reaumur remarked that the cells of this bee which he found at Bercy, were situated in a northern exposure, contrary to what he had remarked in the mason-bee, which prefers the south. The cells at Largs, however, were on an elevated bank, facing the south, near Sir Thomas Brisbane's observatory. With respect to exposure, indeed, no certain rule seems applicable; for the nests of mason-bees which we found on the wall of Greenwich Park faced the north-east, and we have often found carpenter-bees make choice of a similar situation. In one instance, we found carpenter-bees working indifferently on the north-east and south-west side of the same post. As we did not perceive any heaps of earth near the holes at Largs, we concluded that it must either have been carried off piecemeal when they were dug, or that they were old holes re-occupied,—a circumstance common with bees,—and that the rubbish had been trodden down by passengers. Reaumur, who so minutely describes the subsequent opera-

tions of the bee, says nothing respecting its excavations. One of these holes is about three inches deep, gradually widening as it descends, till it assumes the form of a small Florence flask. The interior of this is rendered smooth, uniform, and polished, in order to adapt it to the tapestry with which it is intended to be hung, and which is the next step in the process. The material used for tapestry by the insect upholsterer is supplied by the petals of the scarlet field-poppy, from which she successively cuts off small pieces of an oval shape, seizes them between her legs, and conveys them to the nest. She begins her work at the bottom, which she overlays with three or four leaves in thickness, and the sides have never less than two. When she finds that the piece she has brought is too large to fit the place intended, she cuts off what is superfluous, and carries away the shreds. By cutting the fresh petal of a poppy with a pair of scissors, we may perceive the difficulty of keeping the piece free from wrinkles and shrivelling; but the bee knows how to spread the pieces which she uses as smooth as glass. When she has in this manner hung the little chamber all round with this splendid scarlet tapestry, of which she is not sparing, but extends it even beyond the entrance, she then fills it with the pollen of flowers mixed with honey, to the height of about half an inch. In this magazine of provisions for her future progeny she lays an egg, and over it folds down the tapestry of poppy petals from above. The upper part is then filled in with earth; but Latreille says, he has observed more than one cell constructed in a single excavation. This may account for Reaumur's describing them as sometimes seven inches deep,—a circumstance which Latreille, however, thinks very surprising. It will, perhaps, be impossible ever to ascertain, beyond a doubt, whether the tapestry-bee is led to select the brilliant petals of the poppy from their colour, or from any other quality they may possess, of softness or of warmth for instance. Reaumur thinks that the largeness, united with the flexibility of the poppy-leaves, determines her choice. Yet it is not improbable that her eye may be gratified by the appearance of her nest;—that she may possess a feeling of the beautiful in colour, and may look with complacency upon the delicate hangings of the apartment which she destines for her offspring. Why should not an insect be supposed to have a glimmering of the value of ornament? How can we pronounce, from our limited notion of the mode in which the inferior animals think and act, that their gratifications are wholly bounded by the positive utility of the objects which surround them? Why does a dog howl at the sound of a bugle, but because it offends his organs of hearing?—and why, therefore, may not a bee feel gladness in the brilliant hues of her scarlet drapery, because they are grateful to her organs of sight? All these little creatures work, probably, with more neat-

ness and finish than is absolutely essential for comfort; and this circumstance alone would imply that they have something of taste to exhibit, which produces to them a pleasurable emotion."

The Rev. Mr. Kirby has discovered that there are no less than two hundred and twenty-one distinct species of bees. He divides the Linnæan genus into *mellitta* and *apis*, distinguishing them by their tongues; the insects of the first having short flattish inflected tongues.—See *Goedartius De Insectis*.—*Swammerdam, Biblia Naturæ*.—*Geoffroy, Histoire Abrégée des Insectes*.—*Reaumur, Memoirs*, tom. vi.—*P. Huber on Humble Bees: Transactions of the Linnæan Society*, vol. vi.—*Rennie's Insect Architecture*.—*Kirby's Monographia Apium*.

BEECH,—botanically *Fagus*. A genus of ornamental timber trees, of the amentaceous tribe. The common species, *Fagus sylvatica*, abounds in the woods of Great Britain, and is one of our best known and most ornamental hardy trees. It is a native of the greater portion of northern Europe; but whether it is a native of Great Britain, or was introduced at an early period of our sylvan cultivation, is extremely doubtful. Had it formed any part of our ancient forests, its mast could scarcely have failed to be preserved in our peat mosses along with hazel nuts and pine cones; yet it either does not exist in these mosses, or occurs in such paucity as hitherto to have escaped observation. It usually attains a height of about 70 feet, and sometimes soars to a far greater altitude; it has a grand and massive, though somewhat formal and heavy outline; and it almost vies with the oak in stateliness of character and impressiveness of effect. Its stem is robust and powerful; its bark is smooth and silvery, and gives to the tree a neat, cleanly, and tasteful aspect; its branches are numerous and spreading; its foliage is peculiarly soft, smooth, and pleasing in summer, and becomes deeply tinted and almost gorgeous in its autumnal decay; its male flower has a bell-shaped five-cleft calyx, and from five to twelve stamina, and appears in April and May; and its female flower blooms on the same tree as the male, and has a four-cleft calyx and two or three styles; and its seed is an angular or three-cornered nut, disposed singly or in couples in a mucate, four-valved capsule.

The beech, when standing apart from other trees, and allowed to form its own natural head, is eminently ornamental.—Its timber is almost as necessary to cabinet-makers and turners, especially about London, as the oak is to the ship-builder, or the ash to the plough and cart wright; and it is used also by wheel-wrights for cogs, felloes, and wheelspokes,—by ship-carpenters, for various minor purposes in dock-yards,—by musical instrument makers, for sounding boards,—by coopers, for clap-boards,—and by the general population around some large towns, for firewood. Evelyn says, "Where it lies dry, or wet and dry, it is exceedingly obnoxious to the worm;

but being put ten days in water, it will exceedingly resist the worm."—Young plants bear lopping without any damage, and may easily be trained to form dense and lofty hedges. In some districts of Belgium, particularly in the vicinity of the village of St. Nicholas, between Ghent and Antwerp, very elegant and compact fences are formed by planting young beeches seven or eight inches apart, binding them together during the first season with osiers, and so bending and training them in opposite directions as to make them cross one another, and form a trellis, with apertures of four or five inches in diameter. Ordinary beech hedges, however, are much less suitable than thorn ones for a farm, and serve best for the boundaries of a villa-ground, or the great divisions of a large garden.—The leaves, when gathered in autumn, before being injured by frost, make far better mattresses than either straw or chaff, and continue sweet and soft during seven or eight years; and they are also successfully employed, along with the leaves of other trees, in forming hotbeds, and protecting covers for forcing sea-kale, asparagus, and other esculent plants.—The male catkins, when carefully collected and dried, and stored up for use, form an excellent packing for fruit; for they are as soft as cotton, and do not communicate any flavour to the fruit.

The nut or seed, popularly called beech mast, is pleasant to the taste; when eaten in great quantities, it occasions giddiness and headache; when well dried and powdered, it may be made into wholesome bread; and when dried and carefully roasted, it can be used as a substitute for coffee. Hogs are very fond of the mast; and in some districts of England, where there are extensive beech woods, these animals are maintained, for successive months, entirely on this food. They thrive exceedingly on it; and many, of less than a year old, are killed for the market, after having been fattened exclusively with the mast; though others, which have been fed for four or five weeks on barley-meal or pease, yield better pork. A distemper called the garget, is liable to be produced in hogs from feeding on either beech-mast or acorns; and this may be prevented, by giving the animals, on every alternate day for two or three weeks, a few pease or beans, moistened with water, and sprinkled with a little finely-pulverized antimony.—An useful oil is obtained from beech nuts by expression; it is nearly equal in flavour and delicacy to the best olive oil; it can be kept longer than that oil without becoming rancid; and it is used by the poorer inhabitants of Silesia as a substitute for butter. Two millions of bushels of beech nuts have been obtained, in a single season, from the forests of Eu and Crécy, in the department of the Oise. The refuse of the nuts, after the expression of the oil, is given as food to poultry, swine, and cattle.—The wood of beech affords a large quantity of alkali, and makes excellent

charcoal. The ashes of beech wood contain 11.72 per cent. of the carbonate of potash, 12.37 of the carbonate of soda, 3.49 of the sulphate of potash, 49.54 of the carbonate of lime, 7.74 of magnesia, 3.32 of the phosphate of lime, 2.92 of the phosphate of magnesia, 0.76 of the phosphate of iron, 1.51 of the phosphate of alumina, 1.59 of the phosphate of manganese, and 2.46 of silica; and the ashes of beech bark contain 3.02 per cent. of the carbonates of potash and soda and the sulphate of potash, 64.76 of carbonate of lime, 16.9 of magnesia, 2.71 of phosphate of lime, 0.66 of phosphate of magnesia, 0.46 of phosphate of iron, 0.84 of phosphate of alumina, and 9.04 of silica.

The beech succeeds best upon dry, chalky, or limestone heights; it attains a great size on ordinary soils in any sheltered situation; and it, at the same time, offers a very sturdy and triumphant resistance to westerly gales. It greatly prevails throughout the range of chalk hills, which extends from Dorsetshire, through Wiltshire, Hampshire, Surrey, Sussex, and Kent, and partly into Berkshire, Buckinghamshire, and Hertfordshire; and it is also comparatively abundant on the Cotswold hills in Gloucestershire, and in some districts of Monmouthshire. It usually has a very flourishing condition, in particular, on the hills of Surrey and Kent, upon the declivities of the Cotswold and Stroudwater hills, and on the banks of the river Wye. It thrives on the thin-soiled schistose hills of Devonshire, and on the granitic heights of the Scottish Highlands; and it has been planted, in large quantities, by the Earl of Fife in Morayshire, and by George Ross, Esq., of Cromarty.

Some very noble specimens of beech exist, or were but recently destroyed, in various parts of Great Britain. A beech tree at Prestonhall, in Mid-Lothian, has a girth of 17 feet 3 inches at one foot from the ground, of 14 feet 7 inches at 3 feet, and of 14 feet 6 inches at four feet. A beech at Newbattle Abbey, in Mid-Lothian, supposed to have been planted about the middle of the 16th century, and blown down early in the present century, measured 17 feet in girth, and contained upwards of 1,000 measurable feet or about 25 tons of timber. A beech at Ormiston Hall, in Haddingtonshire, in 1762, measured 18 feet 10 inches in girth, and had been artificially made hollow, so as to serve for a small shelter-house. A beech near Oxenford Castle, in Mid-Lothian, in 1763, measured 19½ feet in girth at 3 feet from the ground. A thriving beech at Earlsmill in Morayshire, in 1812, measured about 20 feet in girth at the ground, and 15 feet in girth at 3 feet from the ground. A magnificent beech at Korole Park, in Kent, measures 24 feet in circumference at 3 feet from the ground, and ten feet in circumference at 27 feet; it rises to the height of 105 feet; it spreads its boughs to the extent of 123 feet; and it contains 498 feet of solid timber. A beech in the Roy Wood at Castle-Howard, measures 15 feet 2 inches in girth at

3 feet from the ground, and rises to the height of 90 feet. The largest tree in a grove of beeches at Woburn Abbey, has a height of 100 feet, and contains 400 feet of solid timber.

The beech is propagated from seeds. Evelyn says that the treatment in the nursery is the same as for the ash, and the treatment in the wood the same as for the oak; and he adds that "the masts are to be sown in autumn or later, even after January, or rather nearer the spring, to preserve them from vermin, which are very great devourers of them. But they are likewise to be planted of young seedlings, to be drawn out of the places where the fruitful trees abound." Miller says, "The season for sowing the mast is any time from October to February, only observing to secure the seeds from vermin when early sown, which if carefully done, the sooner they are sown the better, after they are fully ripe." Hanbury gives nearly the same instructions as Evelyn, but orders the masts to be gathered in September, dried for six days in an airy place on mats, and preserved in bags till the time of sowing. The masts should be sown an inch deep, in well prepared beds; and the young plants, after having stood two years in the beds, should be removed to the nursery, and left there till wanted for final planting.

The transplanting of beech trees of large size can be effected with little risk; and a good method of doing this was recorded, at least 50 years ago, by Lord Caernarvon. "The best way of planting large beech trees," says he, "is to cut in the lateral branches not close to the body, in the beginning of February; and, in the autumn following, or even in the same spring, to cut round the roots, and fill the earth in, letting it stand till the succeeding autumn or longer, by which time the tree will have made young branches and young roots, and be in vigour, and fit, upon removal, to push immediate roots. It should be taken up without cutting the roots much more and put into a hole with the earth in mud, filled in and well staked. The young roots will immediately strike, and the young branches shoot. Planting in earth made thick with mud is an excellent way. The tree should be planted level with the ground; it suffers, if sunk below the level of the ground. The top or leading branch of a beech, indeed of any tree, should not be cut off."

The purple beech, *Fagus sylvatica purpurea*, is a well-known and very ornamental variety of the common beech. It has been regarded by some cultivators as a distinct species; but though a few plants raised from its seeds partake of its own peculiarities, the great majority completely revert to the common or normal character. The purple beech is supposed by some botanists to have been obtained from Germany; but it is really of unknown origin. Its grand peculiarity is the constant brilliant purple colour of its leaves; and this renders the tree everywhere conspicuous and arresting, whether grown as a shrub, in the

hedge, or on the lawn; but it occurs in considerable diversity of depth and shade, and might be made the characteristic of several subvarieties.

A number of purple beeches, both in Great Britain and North America, have grown to the height of about 30 feet; and trees of it are supposed to be capable of regularly attaining twice that height; yet those only which retain their purple colour from seed acquire full altitude, those which are produced by grafting on the common beech attain medium size, and all those which are obtained by layering are dwarfed, and can be treated only as shrubs or mere mimic trees.—The other best known varieties of the common species are the copper beech, *Fagus sylvatica cuprea*, growing to the height of 70 feet; the various-leaved beech, *F. s. heterophylla*, growing to the height of 40 feet; the crested-leaved beech, *F. s. cristata*, growing to the height of 30 feet; the dark-red-leaved beech, *F. s. atropurpurea*, growing to the height of 30 feet; the cut-leaved beech, *F. s. incisa*, growing to the height of 10 feet; the silver variegated leaved beech, *F. s. foliis argenteis*; the gold variegated leaved beech, *F. s. foliis aureis*; and the pendulous or weeping beech, *F. s. pendula*.

The American or red beech, *Fagus ferruginea*, grows indigenously in Canada, New Brunswick, Nova Scotia, and the north-eastern parts of the United States, and was introduced to Great Britain in 1766. It is named, not from the colour of its leaves, but from that of its timber; and it possesses none of the distinguishing characters of the purple and the copper beeches. It usually attains a height of about 30 feet, ramifies near the ground, and has a massive outline and a tufted summit. Its leaves are smooth, shining, serrated, and somewhat large and thick; and its timber has sufficient strength, solidity, and toughness to be occasionally used as a substitute for oak. Michaux says that "the European beech bears so strict an analogy to the red beech, that it may be useful to notice its properties, its uses, and the means by which its duration is secured in important structures. Experience has demonstrated the advantages of felling the (red) beech in the summer, while the sap is in full circulation: cut at this season, it is very durable; but felled in the winter, it decays in a few years. The logs are left several months in the shade before they are hewn, care being taken that they do not repose immediately upon the ground; after which they are fashioned according to the use for which they are destined, and laid in water for three or four months." The very singular circumstance that the red beech does best to be felled in summer, seems to indicate that the juices of the tree possess some peculiar, though hitherto unknown chemical principle.—An ornamental variety of the red beech is the Carolinian beech, *Fagus ferruginea caroliniana*.

The white beech, *Fagus sylvestris*, like the preceding species, is a native of North America, and

takes its name from the colour of its timber. It abounds in the middle and western states of America; and occurs, in its finest condition, on the banks of the Ohio, between Gallipolis and Marietta. Specimens of it were measured by Michaux, 11 feet in girth, and upwards of 100 feet in height. Its roots form a bold, decurrent net-work on the surface of the forest ground; its head is more slender and less ramified than that of the red beech; its outline is very imposing; and its foliage consists of oval-acuminate, smooth, and shining leaves, and is quite superb. Its duramen or perfect wood bears a remarkably small proportion to its alburnum, and frequently occupies but three inches in a trunk of 18 inches in diameter. The bark of old trees is smooth, thick, entire, and of a grey colour; and is sometimes used by tanners as a substitute for oak-bark.

The fern-leaved beech, *Fagus Comptoniaefolia*, is a curious though puny plant, and may be considered as rather a variety than a species.—The birch-like beech, *Fagus betuloides*,—sometimes mistakenly called *Fagus antarctica*,—is a hardy, ornamental evergreen tree of the country around the Straits of Magellan, grows to the height of 50 feet, and was introduced to Great Britain in 1830. Station Island, on the east coast of Terra del Fuego, is covered with woods to the very summit of its hills; and the birch-like beech is a principal element in these woods, and makes the island appear as if covered with perpetual verdure.—The antarctic beech, *Fagus antarctica*, grows to the same height as the preceding, is a native of the same country, and was introduced to Great Britain in the same year; but while the other is evergreen, this is deciduous.—*Gilpin's Forest Scenery*.—*Strutt's Sylva Britannica*.—*Nicol's Planter's Kalendar*.—*Museum Rusticum*.—*London's Hortus Britannicus*.—*Marshall on Planting*.—*Miller's Dictionary*.—*Liebig's Chemistry of Agr.*—*Useful and Ornamental Planting*.—*Bath Papers*.—*Gardener's Magazine*.—*Doyle's Husbandry*.

BEER. The fermented infusion of malted barley, flavoured with hops, and used as a general beverage. The name of beer is also applied—but improperly—to several other beverages made from saccharine liquors, subjected to a partial fermentation, and flavoured with different substances, for instance, spruce-beer, ginger-beer, molasses-beer.

The main ingredients of beer are, besides water: alcohol, the bitter principle (lupuline or lupulite), and aromatic volatile oil of hops, gum, sugar, empyreumatic principle from the malt, when kiln-dried, small quantities of nitrogenized substances (gluten), brown extractive, a small portion of tannin (hops), and carbonic acid. The sugar, gum, and other solid ingredients, which remain on evaporation, are generally comprised under the name of *malt-extract*; on its quantity depends the body of the beer, while by its strength is generally meant its content of alcohol. Its in-

toxicating property depends, however, a great deal on the bitter and narcotic substance of the hops. From wine, it differs not only in this respect, and in its smaller proportions of alcohol, but also in containing a much larger quantity of nutritive matter.

The following table shows the quantity of alcohol in some beers.

	Proportion of Spirit of sp. gr. 0.825.	
	Per ct. by meas.	Per ct. by wt.
Ale, Burton,	8.88	7.326
average,	6.87	5.667
Brown stout,	6.80	5.610
London porter (average),	4.20	3.465
Small beer,	1.28	1.056

The difference in the different varieties of beer depends upon a difference in the materials employed, or in the process and management of the brewing. In regard to the materials, beers differ according to the different kinds of malt employed, and its proportion to the quantity of hops and of water. To the class of *table* or *small beers*, all those may be referred, whose specific gravity does not exceed 1.025, and which contain about 5 per cent. of malt extract. Beers of middling strength have generally a spec. grav. of from 1.025 to 1.040. Some of the Scotch and English ales form some of the strongest and heaviest kinds of beer.

The following table indicates the spec. grav. of some of the English beers.

	Spec. grav.
Ale, Burton, 1st sort,	1.111 to 1.120
" 2d "	1.097 to 1.111
" 3d "	1.077 to 1.092
Common,	1.070 to 1.073
"	1.058
Porter, common sort,	1.050
" double,	1.055
Brown stout,	1.064
" " best,	1.072
Beer, common small,	1.014
" good table,	1.033 to 1.039

The colour of the beer depends upon the colour of the malt and the duration of the boil in the copper. Pale ale is made from steam or sun-dried malt, and the young shoots of the hop, the deep yellow ale from a mixture of pale yellow and brown malt, and the dark brown beer from well kilned and partly carbonized or parched malt, mixed with a good deal of the pale, to give body. The longer and more strongly the malt has been heated in the kiln, the smaller is the quantity of extract it yields, *cæteris paribus*. Porter is generally prepared from high-dried or rather charred malt, which, therefore, has had much of its saccharine matter destroyed by heat. Hence its deep colour, and the absence of any sweet taste, while ale has a sweetish taste, and contains a much larger quantity of saccharine matter.

The greater or less rapidity of the temperature, and the manner in which the worts are made to ferment, have a remarkable influence upon the quality of the beer, especially in reference to its fitness for keeping. Under the article FERMENTATION, it will be shown that two kinds of

fermentation may be distinguished, the upper and the lower or bottom-fermentation. The former is a much more active fermentation, by which, according to Liebig, the gluten is only partly oxidized, at the expense of the oxygen of a portion of the sugar, while a great portion remains dissolved in the liquor, and by its subsequent oxidation is apt to transfer oxygen to the alcohol, and render it sour, unless it be kept at a very low temperature. This is still more the case, if during a too violent fermentation the temperature rises too high, and especially if the air be not perfectly excluded, and a considerable quantity of acetic acid be formed, by which an additional quantity of glutinous matter is dissolved, and it thus is not only rendered apt to spoil from the slightest causes, but loses also its limpidity and assumes a disagreeable taste, or becomes *yeast bitten*. By the lower fermentation, on the contrary, the conversion of the sugar into alcohol is performed very slowly and without any considerable rise of temperature, so that the gluten is completely oxidized and precipitated by the oxygen of the air and without conversion of any alcohol into acetic acid, so that the resulting beer—as is the case with Bavarian beer—is not liable to become sour, or to undergo the acetous fermentation. Where this is not the case, the tendency to become sour is generally remedied by a large addition of hops, and a greater proportion of malt, by which the beer becomes more narcotic and intoxicating, and less agreeable to the taste, and such beer is then often considered as drugged.

A main feature of good beer is its fine colour and transparency, the production of which, therefore, is an object of great interest to the brewer. Attempts to clarify the beer in the casks seldom fail to do it harm. The only thing that can be used with advantage for *fining* a muddy or foul beer, is isinglass. For porter, as commonly brewed, it is frequently had recourse to. To ascertain whether the beer is in a state fit for fining, put some of it in a long cylindrical glass vessel, and add to it a teaspoonful of the fining, and shake it well with it, closing the mouth of the vessel with the finger or the palm of the hand. Its aptitude to become bright will then soon be evident, by the mixture first becoming curdy, and then on repose separating, the finings generally rising to the top, and leaving the liquid below clear and brilliant.

That beer is nutritive, and, when used in moderation, salubrious, can scarcely be doubted. It proves a refreshing drink and an agreeable and valuable stimulus and support to those who have to undergo much bodily fatigue. The hop operates as a tonic, and assists digestion. With dyspeptics, beer as well as other fermented liquors are very apt to disagree, and should therefore be avoided. It is also objectionable to those liable to lithic acid deposits, and for plethoric persons, who have a tendency to apoplexy. Ale contain-

ing a much larger proportion of saccharine matter is more objectionable for diabetic and dyspeptic patients than porter.

Examination of Beer.—The examination of beer has principally for its object to estimate the quantity of its ordinary ingredients, and to discover the admixture of foreign, accidental, or designed substances or adulterations.

Beer ought to be perfectly clear; turbidness indicates either that the fermentation has not been complete, or that the formation of acetic acid has begun. The greater or less colour indicates the degree of heat to which the malt has been exposed and the length of time the wort has been boiled. The frothing, when poured out, depends on the variety of the beer and the manner of keeping it in casks or in bottles. Beer containing but little carbonic acid has a flat taste. The smell of beer depends on the hops, the malt, the alcohol, and the carbonic acid. By addition of common salt, and gentle heating, the smell of the hops is made more apparent, and may be better judged of in regard to its quantity and quality. The taste will still better decide as to the quantity and quality of the hops employed, and the body of the beer.

In examinations of beer, the amounts of the following ingredients are generally ascertained: *malt extract* (see the former part of this article), *alcohol*, *water*, and *carbonic acid*. The quantity of the last does not usually amount to more than 0.1 or 0.2 per cent.; its exact proportion is therefore often neglected, especially as its relative quantity is apparent from the greater or less frothing. In general, a quantitative estimation is therefore desired only of the malt extract and the alcohol, from which, then, the quantity of water results by deduction. This, in combination with its effect on the senses, will give a good idea of the quality of the beer.

In order to ascertain the amount of *malt extract*, a weighed quantity of beer is evaporated cautiously, and the residue weighed. It is, however, difficult to obtain it perfectly dry, as the last portion of water requires a rather high temperature for its expulsion, which might cause it to commence decomposing.

The amount of *alcohol* is ascertained by distilling a weighed portion of beer in a retort, and, from the weight and specific gravity of the distilled liquid, determining its content of alcohol.

It has already been mentioned above that solutions of malt extract and of sugar of the same spec. grav. contain an equal amount of solid matter. If, therefore, a weighed quantity of beer be heated until all carbonic acid and alcohol has been expelled, and the remaining portion again diluted with water until it has attained its previous weight, the amount of malt extract may be determined from its specific gravity. If, moreover, the specific gravity of the beer be previously ascertained, the amount of alcohol may be estimated from the difference in the two spe-

cific gravities. The contained carbonic acid affects the specific gravity but very slightly, and the greater part may be removed by gently heating and shaking the liquid. Let the specific gravity of a beer be found to be 1.025, and after the expulsion of the carbonic acid and the alcohol by boiling, and subsequent dilution with water to the original weight of the beer, to be 1.032. The latter specific gravity corresponds to 8 per cent. of malt extract. The difference between the specific gravities 1.032 and 1.025 is 0.007, which therefore will constitute the difference in specific gravity between pure water and dilute spirit containing the same amount of alcohol as the beer, or having the specific gravity of 0.993 (1.000—0.007), which corresponds to 4 per cent. alcohol by weight, or 5 per cent. by volume, as the following table will show, which we add for convenience:

Per ct. of alcohol.	Spec. grav. of spirit at 63.5 Fah.	
	Per ct. by weight.	Per ct. by volume.
12	0.9806	0.9834
11	0.9817	0.9846
10	0.9830	0.9859
9	0.9844	0.9873
8	0.9860	0.9887
7	0.9878	0.9901
6	0.9897	0.9915
5	0.9914	0.9929
4	0.9931	0.9943
3	0.9948	0.9957
2	0.9965	0.9971
1	0.9982	0.9985

It may, however, be remarked that this method, in order to yield satisfactory results, requires the specific gravities to be taken with great accuracy, either by a delicate hydrometer, or a spec. grav. bottle, and with due regard to temperature.

The amount of *carbonic acid* may be ascertained by heating a weighed quantity of beer, and collecting the expelled carbonic acid, with the necessary precautions, in a pneumatic apparatus, determining its quantity by volume, from which its weight may then be calculated. Another method consists in introducing a weighed quantity of the beer into a bottle or flask, in the orifice of which is fitted, by means of a perforated cork, a tube containing chloride of calcium, and heating very slowly the contents of the flask almost to ebullition, by which the carbonic acid is expelled, while the vapours of water and alcohol are retained by the chloride of calcium. The loss in weight of the whole apparatus before and after the experiment then indicates the amount of carbonic acid.

If desired, the sugar and gum of the malt extract may be separated by moderately strong alcohol. The extract is first made by water into a thin syrup, and then alcohol added as long as gum precipitates, which by repetition of the same treatment may be freed almost perfectly from sugar. The quantity of sugar may also be determined by the quantity of carbonic acid which it yields by fermentation (see the article *SUGAR*). A content in the gum of unaltered starch may be ascertained by a solution of iodine.

The presence of foreign substances, either

accidental or designed, are often proved with difficulty by chemical tests. Among such adulterations may be mentioned sulphate of iron, alum, and salt, added under the name of *beer heading*, to impart a frothing property to it.

BEESTING, or BIESTING. The first milk taken from a cow after her calving. It is thick, yellow, and different in chemical composition from ordinary milk. If it be not drawn clean off after a cow's first calving, she may not have a proper flow, or even any flow whatever, of ordinary milk.

BEET,—botanically *Beta*. A genus of herbaceous plants, of the goosefoot tribe. The species are seven or eight in number, and are distinguished from those of other genera of the goosefoot family, by having a large succulent root, and a green calyx united halfway to a hard rugged nut. Three species are culinary; two are unfit for economical purposes; and two or three, besides varieties, are extensively cultivated in the field. The three-styled species is a perennial; and all the other species are biennials.

The common beet, *Beta vulgaris*, is a native of the shores of the Mediterranean, and was introduced to Great Britain about the middle of the 16th century. It grows wild in Egypt and the maritime districts of the south of Europe; and has long been cultivated in British gardens for the sake of its sweet, tender, carrot-like roots. The principal varieties of it are the green, the red-rooted, and the yellow-rooted,—*viridis*, *rubra*, and *lutea*. The leaves of the green variety are used either as a pot herb in mixture with other vegetables, or a plain boiled esculent served to the table by itself; and the roots of the red variety are used for pickling, or boiled for slicing cold in salads, or eaten as a salad by themselves with spice and vinegar. The small red subvariety and the long yellow subvariety have the reputation of being the sweetest, the most delicate, and the richest in flavour; and are cultivated with extraordinary care at Castelnaudary in France, and known to the French as the red and the yellow beets of Castelnaudary. Any of the varieties become forked in the roots, and comparatively destitute of succulency, when grown upon stiff or stony land, and can be obtained in perfection only on light sandy soils, which their roots can easily penetrate. The short or turnip rooted sorts do best for shallow or loamy land; and the long-rooted kinds are most suitable for light deep soils. The seeds must be sown in the end of March or beginning of April, and well covered with soil; the young plants, whether in drills or beds, must be thinned out to distances from one another of one foot in ordinary land, or of 18 inches on land of the most suitable kind; and the roots for the table ought to be taken up in September, and stored with sand in a dry place inaccessible to frost, and will remain good during winter, but will become stringy in spring.

A good brown bread may be produced by rasping down the red beet root and mixing it with an equal

quantity of flour. In the 'Gardeners' Chronicle,' Dr. Lyon Playfair gives the following account of experiments he has made to test the relative economy of wheat and beet as materials for making bread. "The average quality of flour contains from 10 to 12 per cent. of azotised principles adapted for the formation of flesh. The average quality of beet contains from 1½ to 2 per cent. of the same constituents. Let us assume 12 per cent. for wheat, and 2 per cent. for beet for our calculations. Now 1 stone—14 lbs.—of wheat contains 1.68 lb., and 1 stone of beet 0.28 lb. of flesh-forming matter, from which the market value of all the materials fitted for the production of flesh may be calculated. A stone of wheat costs 2s. 10d., and the same weight of beet, 2d. But the relative value of wheat to beet, as regards true nutrition, being 6 to 1, it follows, that 6 stones of beet, costing 1s., are equal to 1 stone of flour, costing 2s. 10d. In other words, the economic value of wheaten flour to the consumer, at present prices [1847], is 2½ times less than that of beet for the same amount of food. This, however, is only one element in the calculation. Flour, on an average, contains 70 per cent. of starch, 5 per cent. of sugar, and 3 of gum; in all, 78 of matter adapted for the support of animal heat. Beet has sugar instead of starch, generally about 8 per cent., and 2 per cent. of other matters fitted for the same purpose, in all 10 per cent. Hence the quantitative value of wheat compared with beet for the important purpose of supporting animal heat is as 7½ : 1, (say in round numbers, 8 : 1). But the economic value can only be obtained by reference to prices. Now 1 stone of wheat costs 2s. 10d., and is equivalent in respiratory value to 8 stones of beet costing 1s. 4d., so that in this point of view also, beet has a superior economic value. To reduce these calculations to a condensed form:—One stone of wheat costs 2s. 10d., and is equal in value as true nutriment to 6 stones of beet, costing only 1s., and, in respiratory value, to less than 8 stones of beet costing 1s. 4d. In general terms, the economic value of beet as an article of food, at present market prices, is between 2 and 3 times greater than the economic value of flour.

The field beet, or mangel-wurzel, is regarded by some botanists as a distinct species under the name of *Beta altissima*, and by others as a hybrid between the red beet and white beet, or *Beta vulgaris* and *Beta cicla*, under the name of *Beta hybrida*. But, as it makes a prominent figure in agriculture, and is far more generally known under its German name than as a beet, we reserve a notice of it for the article MANGEL-WURZEL.—The long-rooted beet, though a common name of a variety of the *Beta vulgaris*, is properly the name of a distinct species, which was introduced to Great Britain from the Caucasus in 1820. This species is botanically as well as popularly named long-rooted,—*Beta macrorhiza*; and is readily distinguishable from all the varieties of *Beta vulgaris* by its usually growing to the height of six feet, while they usually grow to the height of only four.

The Sicilian or white beet, also called the chard, *Beta cicla*, is a native of Portugal, and was introduced to Great Britain in 1570. Its root is seldom larger than a man's thumb; its stem grows erect, and usually attains the height of about six feet; its leaves are oblong spear-shaped, and grow close to the stem; its lower leaves are thick, succulent, and have broad footstalks, and

remarkably thick midribs; and its flower-spikes are produced from the wings of the leaves, and have narrow leaflets between the flowers. Its leaves are white, yellow, green, orange, or deep crimson, according to the variety; and its principal varieties are the common white beet, and the great white beet or Swiss chard. The stem and the leaf-rib are peeled and dressed like asparagus or scorzonera, and are the parts properly called chards; and the leaves, deprived of these parts, are used as a pot herb. The seeds ought to be sown thinly, on an open and not too moist spot of ground, in the beginning of March. If the plants rise crowdedly, the leaves will be small, full of fibres, and comparatively worthless; and the common white ought not to be left nearer to one another than six inches,—the Swiss chard not nearer than ten inches. Frequent hoeings are required; and one bed of plants will yield leaves for use till the end of the second season.

The sea beet, *Beta maritima*, grows wild on the sea-coast and in salt marshes, in various parts of England. It has a prostrate habit, usually attains a length of only about a foot, and has a tough woody root, and numerous entangled branches. Its leaves are small, oval-shaped, rather sharply pointed, succulent, and of a deep green colour; and its flowers are produced in spikes, and appear in August. Its leaves are used as spinach; and, when well dressed, are delicate, well-flavoured, and easily reducible to pulp. It is propagated from seeds in the same manner as the common beet; and it thrives in almost any garden soil, with little cultivation.—The curled beet, *Beta crispa*, was introduced to Britain from the south of Europe in 1800; and it grows to the height of six feet, and is a hardy culinary plant.—The three-styled beet, *Beta trigyna*, is a rather pretty but nearly useless plant from Hungary.—The spreading beet, *Beta patula*, is an uninteresting and half-tender plant from Madeira.

BEET SUGAR. Crystallized sugar, manufactured from the root of the white beet. Chemists have, for about a century, been aware of the saccharine wealth of different kinds of beet; a functionary of Berlin first publicly proposed the manufacture of sugar from beet, by boiling, slicing, and pressing the roots; Buonaparte caused beet to be annually cultivated, to the aggregate extent of upwards of 100,000 acres, in order to afford a substitute for the British colonial sugar, which he forbade to be imported; many establishments, small and great, private and public, have since been set up, in several countries of Europe, for the manufacture of beet sugar; and some fond speculations have occasionally been entertained as to the probability of this manufacture becoming an important department of British industry, and a valuable stimulus to the labours of agriculture. But either to sketch a history of the manufacture, or

to attempt an estimate of its capabilities, would be to accumulate an enormous mass of both political and fiscal matter, totally unsuited to the character of our work.

One brief passage may serve as a specimen of the whole. While the French government encouraged the manufacture of beet sugar, experiments were made on a considerable scale, and with great success, in the town of Bruges. "The machinery was inexpensive, and the remaining cost was merely that of manual labour, and a moderate consumption of fuel. The material itself came at a very low rate, about ten shillings British by the ton; and to this circumstance may be chiefly attributed the cessation of the manufacture. Instead of encouraging the cultivator, the government leaned altogether to the manufacturer, and made it imperative on every farmer to give up a certain portion of his land to this root, without securing to him a fair remuneration. The consequence was, that the manufacturers, thus supported, and taking advantage of the constrained supply, have, in many instances, been known to refuse payment even of the carriage of a parcel, in other respects sent in gratuitously; and a consequence still more natural was, that the farmers, wherever they had the opportunity of shaking off so profitless a crop, converted the space it occupied to better purposes. To the manufacturer, the profit was ample; an equal quantity of sugar with that of the West Indies, which at that time sold for five shillings the pound, could be produced on the spot from mangel-wurzel at less than one shilling by the pound; and to such perfection had the sugar thus made arrived, that the prefect, mayor, and some of the chief persons of Bruges, who were invited by a manufacturer to witness the results of his experiments, allowed the specimens he produced to exceed those of the foreign sugar." —[*Newby's Beta Depicta*.]

The root of the white beet, although so largely employed in Europe in the manufacture of sugar, has not received a very minute chemical investigation. The following substances have been found in the white Silesian beet, and nearly in the proportions indicated:—

Water, on an average	84.0
Crystallizable sugar (average)	10.0
Vegetable fibre	2.0
Albumen and nitrogenous substance	1.5
Pectin, malic acid, colouring and aromatic substances, fixed oil, bitter essential oil, chlorophyll, asparagin, oxalate of lime, phosphates of lime and magnesia, malate and phosphate of ammonia, sulphate, nitrate and oxalate of potassa, chlorides of potassium and sodium, sulphur, silica and oxide of iron	2.5
	<hr/> 100.00

The quantity of sugar varies from 8 to 12 per cent., but in the progress of manufacture a portion of it is rendered uncrystallizable. Although a large yield might be expected from the above

analysis, the quantity of juice obtained on an average is about 66 per cent. with 34 per cent. pulp, and the amount of sugar about 5 per cent. of the weight of the root.

The following is the ordinary process of extracting the sugar from this plant:—The roots are reduced to a pulp by pressing them between two rough cylinders; the pulp is then put into bags, and the sap it contains is pressed out. The liquor is then boiled, and the saccharine matter precipitated by quicklime; the liquor is now poured off, and to the residuum is added a solution of sulphuric acid, and again boiled; the lime uniting with the acid, is got rid of by straining; and the liquor is then gently evaporated, or left to granulate slowly, after which it is ready for undergoing the common process of refining raw sugars. The French manufacturers have acquired so much experience in this process, that, from every 100 lbs. of beet, they extract 12 lbs. of sugar in the short space of twelve hours. The total quantity of beet root sugar manufactured in France in the year 1845–6 amounted to 39,403,754 kilogrammes, or nearly 40,000 tons.

BEETLE. A hand wooden implement, of the nature of a mallet, very various in size, form, and uses. A small one-handed beetle is used for beating clothes; a larger one-handed beetle is used by cottage-farmers, as a substitute for a roller, for pulverizing the clods of loamy and clayey soils; and a still larger beetle, with one, two, or more handles, is used for splitting wood, and driving wedges and hedge-stakes.

BEETLE. A very extensive and interesting order of insects. It includes the turnip-fly, and the wood-eating insects of all the weevils, and possesses, in consequence, an intense though disastrous interest for the gardener and the farmer. Upwards of 3,500 British species of beetles have been described by entomologists; about 30,000 species are contained in the French museums; about 20,000 species, not included in the French collections, are supposed to be contained in the museums of other countries; and from 50,000 to 100,000 species are conjectured, from analogies of climate, to exist in regions of the world which have not yet been scientifically explored. This great multitudinousness of the beetles, their wonderful variety of form, the frequent richness and diversity of their colouring, their numerous modifications of external organization, their general superiority in size to insects of other orders, the ease with which they are preserved, and the vast amount of their depredations upon the vegetable world, have occasioned them to be more extensively and enthusiastically investigated than any other order of insects.

The beetles are coextensive with the order *Coleoptera*. Their body consists of, first, the head; next, a large segment usually called the thorax; next, two short segments called the mesothorax and the metathorax, which support the wing-covers and wings, and the two posterior pairs of

legs; and, lastly, a series of rings, composing the abdomen, and unfurnished with organs of locomotion. The head is usually roundish, and is provided with a pair of antennæ; but the latter are of very various form in the different groups and genera. The eyes are composite and faceted. The mouth consists of a labrum or upper lip, a pair of mandibles or horny upper jaws, a pair of maxillæ or less firm lower jaws, provided with a palpus or feeler, and a labium or lower lip, furnished with a pair of feelers, and implanted on a broad horny mentum or chin. The upper end of the abdomen is attached by its entire breadth to the mesothorax; and its upper surface, in consequence of being defended by the wing-covers, is usually of less solid consistence than the under surface. The grand characteristic of the order, however, is its having two membranaceous wings, folded transversely beneath two horny elytra or hard parchment-like sheaths. The elytra form by their union, when closed, a longitudinal suture; they defend the insect, by their hardness and horniness, from the injurious effects of abrasion while it is piercing earth or wood for food or shelter; and they constitute the character which gives the order its scientific name.

The larva of a beetle resembles a soft fleshy worm, and possesses so far a degree of identity with the perfect insect, as, in technical phrase, to render the metamorphosis of the insect incomplete. The head and the upper surface of the thorax are scaly; and six legs are attached in pairs to the three anterior segments of the body. Nearly all the parts of the mouth of the perfect insect are exhibited, in a comparatively undeveloped manner, in the head of the larva; but, in consequence of the greatest supply of nourishment being taken by the insect in its larva state, the jaws are the parts of the mouth most fully developed. Such species of larvæ as lie most inactive and concealed have the closest resemblance to worms or grubs; such as are carnivorous are, in general, the most inert; and the larvæ of the group called rove-beetles, exhibit the nearest resemblance to the perfect insects, or undergo the lowest degree of metamorphosis.

BEEVES. Oxen or black cattle. The word beeves is properly the plural of beef.

BEGGAR'S NEEDLE. See **SHEPHERD'S NEEDLE**.

BEGONIA. A numerous genus of beautiful endogenous plants, forming an order of itself, and nearly allied to the polygonum and gourd families. Five species were introduced to Great Britain during the last three decades of last century; and nearly fifty species have been introduced since the commencement of the present century, and a large proportion of these during the last twenty years. All are natives of the tropics; and considerably more than one-half belong to the wettest tropical districts of America and the West Indies. All are eminently ornamental; and several have already become so extensively

diffused as to be common house-plants, in the workshop and the cottage, as well as in the villa and the mansion, in company with the hydrangea, the fuschia, and the pelargonium. All are evergreens, and have a tender habit, but admit of easy cultivation, and can be maintained in bloom during a large portion of the year. One, the plane-tree-leaved, is a shrub of about 10 feet in height; one, the climbing species, is a twiner of two feet in height; about one-half are under-shrubs of from 1 foot to 3½ feet in height; and the others are either herbaceous or tuberous rooted plants, of from 6 inches to two feet in height. The largest of three divisions of them have unequally cordate leaves; the next division have semicordate leaves; and the smallest division have roundish, ovate, or palmate leaves. The stems of all are succulent; the stipules of all are membranaceous and highly developed; the leaves of all are fleshy, very large, and often richly coloured with crimson; and the flowers of all grow in fur-flowered panicles, and have a very neat appearance,—and those of most are white, of a few are pink, and of two are of a rosy colour. Though all the species are hothouse plants, the only requisites for their cultivation in any inhabited house are a potful of old tan or other vegetable matter, plenty of heat, and frequent and very copious waterings. A collection of them fills a hothouse in the imperial gardens at Schonbrunn, and is quite as fascinating as similar adjacent collections of ferns and palms. The species longest known in Britain are those designated *nitida*, *reniformis*, *hirsuta*, *humilis*, and *acuminata*; and some of the species most recently introduced are those designated *fagifolia*, *castaneifolia*, *Dregii*, *Meyerii*, *acerifolia*, *heracleifolia*, and *sanguinea*.

BEHEN. Several plants of widely different character. One behen is a species of catch-fly, a hardy annual, a native of Crete, producing a white flower in June and July,—*Silene behen*. Another behen is a species of saw-wort, or centaury, a hardy ornamental biennial from the Levant, producing yellow flowers in July and August,—*Serratula behen*, or *Centaurea behen*. A third behen is the common sea-lavender or marsh wild beet, an evergreen herb, growing wild on muddy sea-shores in England, having a height of about a foot, bearing a pretty blue flower from May till August, and prized by the inhabitants of the Essex coast as a medicine,—*Statice Limonium*. And a fourth behen is a species of chickweed, sometimes called the spatling-poppy, growing wild in pastures and corn-fields, and by the sides of roads in Britain, having a round, thick, whitish stem of about two feet in height, broad, oblong, bluish-green leaves, bearing a white flower from May till August, and occupying a place, though both an obscure and a doubtful one, among the *materia medica* of herbalists.

BELLADONNA, or DEADLY NIGHTSHADE,—botanically *Atropa Belladonna*. A very poisonous,

perennial, British plant, of the tribe *Solanee*. Its root is thick, fleshy, and creeping; its stems are annual, erect, herbaceous, purple-coloured, round, branching, leafy, somewhat fleshy, and about four or five feet high; its leaves are lateral, in pairs of unequal size, ovate, pointed, entire, soft and fatty to the touch, of a dusky green colour above, of a paler green below, and changing to purple in autumn; its flowers are solitary, large, drooping, bell-shaped, of a lurid hue without, of a dusky or brownish violet within, of a faint narcotic odour, and bloom in June and July; and the fruit or berry is large, roundish, smooth, shining, longitudinally furrowed on each side, first green in colour, but ripening into a shining black or deep purple, and containing many small kidney-shaped seeds, and a sweetish, semi-nauseous, violet-coloured juice. This plant grows wild amongst rubbish in many parts of Great Britain, and is exceedingly dangerous to persons unacquainted with its properties, and especially to children. Buchanan, in his History of Scotland, says that the Danish army of Sweno were destroyed by means of the juice of belladonna being mixed with a donation of wine and ale which the Scotch, under Macbeth, sent to them during a truce; the Danes becoming stupified by the drink, and the Scotch falling upon them and killing them while they were in a state of stupefaction. The beautiful appearance of the berries often induces children and ignorant adults to taste them; and their sweetish gout tempts some persons to eat a sufficient quantity to produce dangerous or fatal consequences. The leaves, as well as the berries, possess the active properties of the plant; they are inodorous, and have a sweetish, subacid, and slightly nauseous taste; and they do not lose their active properties by drying. The seeds, however, contain the largest proportion of the active properties.

The effects produced on the human system by belladonna are intoxication, violent gesticulation, obstreperous and maniacal laughter, excessive thirst, difficulty of deglutition, nausea, tumefaction of the face, delirium, inflammation of the stomach, paralysis of the intestines, convulsions, and death. The poisonous parts of the plant have been ascertained by chemical analyses to contain an element resembling animal albumen, alkaline salts with a base of potash, and especially a peculiar, bitter, alkaloidal, narcotic substance, which has been designated atropia. According to some experiments of M. Runge, lime-water ought to be the proper antidote for poisoning by belladonna; but, according to the successful treatment hitherto practised, the antidotes are first emetics of sulphate of zinc or sulphate of copper, next purgatives and glysters, and next large doses of vinegar and other vegetable acids. Belladonna is administered to the human subject, in minute doses, by ordinary pharmacutists, as a diuretic, a diaphoretic, and a narcotic, and in extremely minute doses, by homœopathist physi-

cians, for a great variety of purposes ; and it is applied externally to the horse and other animals for diseases of the eye, and exhibited internally in cases of undue action of the nervous and the vascular systems. But for either man or beast, it is far too active and ticklish a medicine, to be prescribed by any person except a regular practitioner. If the extract of belladonna be applied to the feet, it is so actively taken up by the absorbent vessels as to produce the same symptoms as if it were swallowed into the stomach.—The name belladonna signifies 'fair lady,' and is supposed to have been given to this plant in consequence of its juice having been used by the Italian ladies as the principal ingredient in a favourite cosmetic.

BELLADONNA LILLY. A hardy and very beautiful species of amaryllis, called by botanists *Amaryllis belladonna*. It takes its name, meaning 'fair lady,' from the combined delicacy and elegance of its blushing flowers. It grows wild at the Cape of Good Hope, and was introduced to Britain through the medium of Madeira and Portugal. It was formerly grown in enormous quantities in the gardens of Italy, particularly of Tuscany, but has been extensively displaced there by the Jacobea Lily ; it has become naturalized in Madeira ; it is a very general favourite in many parts of Europe ; and it enjoys special reputation in England, both on account of its beauty, and because it is the only amaryllis which can live and prosper in the open ground. When planted six inches deep, on a dry border, with a southern exposure, it will thrive for years, in the south of England, without requiring any care, and in the north of England, with only some ordinary winter covering. Its flowers appear, without the leaves, from August till October, and give an exotic and extremely brilliant appearance to the border ; and its green leaves come up soon after the flowering, remain during all the winter and the spring, and decay in the month of June. Its stems grow to the height of about two feet, and have a rich purplish green colour, with the general suffusion of a thick violet bloom ; and its flowers are produced in clusters at the top of the stems, and have a funnel shape, not less than three inches long, with six divisions curving backward at the points, and are of a rich and delicate flesh colour, varying in depth of tint in different subvarieties of the plant. The principal variety known to botanists is the pale-flowered, — *Amaryllis belladonna pallida*.

BELLFLOWER.—botanically *Campanula*. A very numerous and interesting genus of ornamental flowering plants, forming the type of the natural order *Campanulaceæ*. Yet though this order comprises eleven genera, considerably more than one half of all its species belong to the genus *Campanula*. A bell-like or campanulate shape of form, though giving name to the order, is far from being a characteristic of it, and occurs in the flowers of orders which are exceedingly

different from it, both in other botanic features, and in general vegetable conformation. A squill or a hyacinth, for example, carries an emphatically bell-shaped flower ; yet possesses hardly another property in common with a campanula. The order campanulaceæ, however startling the assertion may appear, have a rather close relation to the exceedingly numerous order *Compositæ* ; being distinguished from it principally in not having their flowers collected into heads, in bearing many-seeded fruit, and in exuding a milky juice.

Upwards of 220 species of the genus *campanula*, besides a considerable number of varieties of the most cultivated species, are known to botanists ; eight of the species, besides some varieties, are natives of Great Britain ; and about 130 species, besides almost all the varieties, are cultivated in British gardens. Ten or eleven of the cultivated species are greenhouse plants ; and all the others are hardy. Eleven are annuals, twenty-eight are biennials, and the remainder are herbaceous perennials. Two or three of the British species are among the most beautiful floral ornaments of our woods and fields ; several of the hardy garden species are universal favourites, and may be seen in almost every tasteful cottage garden ; and two or three of the choicest species rank with the proudest beauties of an ordinary conservatory or a well-furnished parterre. Nearly thirty species of plants, which were formerly included in the genus *campanula*, are now assigned by botanists to other genera, particularly to *adenophora* and *prismatocarpus*, and are not included in our statement of numbers. We must select, for particular notice, only a very few of the most prominent or best known bellflowers.

The round-leaved bellflower, *Campanula rotundifolia*, is a perennial native of Great Britain. One variety of it has blue flowers, and a stem of six inches in height, and usually grows on heaths ; and another variety has white flowers, and a stem of about a foot in height, and usually grows in woods. This species contests with *Scilla non-scripta* the popular name of hare-bell. It frequently occurs on the banks of rivers, on the borders of fields, and on almost every kind of half-waste ground. Its root is somewhat creeping and woody ; its stem is round, erect, smooth, sometimes downy, and very slightly branched ; its leaves are numerous, variously ovate, heart-shaped, and kidney-shaped, and usually wither and fall before the time of bloom ; and its flowers are few and pendant, on long, slender, tremulous footstalks, and appear in July and August. This plant, though very pleasing for its beauty, is a very decided indicator of the comparative barrenness of the soil on which it naturally grows. It is sometimes called the witch's thimble. Two cultivated varieties of it have respectively double blue and double white flowers.

The champion bellflower, *Campanula rapunculus*, is a biennial, and grows wild by the sides of

hedges in Great Britain. Its root is roundish or spindle-shaped, fleshy, white, milky, and sweet, with a bitterish pungency; it was formerly cultivated for the table, in England and very extensively in France, and eaten both raw and variously cooked; and it acquires great improvement in flavour, and increases in size, from cultivation. Its stems are erect, and about two feet high; its leaves are oblong, spear-shaped, and placed alternately; and its small flowers are either blue or white, stand upright close to the stem toward its upper part, and appear in July and August.

The peach-leaved bellflower, *Campanula persicifolia*, is a native of the northern parts of Europe, and was introduced to Great Britain toward the close of the 16th century. It is a perennial, and very hardy, and grows to the height of three feet. Its root consists of many fibres; its stem is angular or channeled, stiff, and variously garnished; its leaves near the root are long, oval, stiff, and without any regular order; its leaves on the stem are longer and narrower than the root leaves, and slightly indented on the edge; and its flowers are produced on short footstalks toward the upper part of the stem. The flowers of the cultivated varieties have either a fine blue or a dazzling white colour, and measure upwards of an inch in width; and both double and semi-double ones have long been so common as to occasion the single-flowering varieties to be neglected. The principal varieties are the common peach-leaved, the largest peach-leaved, the large-flowered, the white-flowered, the double blue-flowered, and the double white-flowered. Any of the varieties can be easily propagated by dividing the roots in autumn.

The nettled bellflower, *Campanula urticifolia*, and the bellflower called throatwort, *Campanula trachelium*, are pretty generally regarded as one species; yet the former, whether viewed as a separate species or as a mere variety, is a native principally of Germany, while the latter is indigenous in the woods of Great Britain. Throatwort receives both its popular and its specific botanic name from its reputed medicinal power in diseases of the throat, decoctions of it, which are bitter and somewhat acrid, having long been used as gargles. Its root is perennial; its stems are stiff, angular, and hairy, and are ramified into a few short side-branches; its pubes or hairs are sometimes as pungent as those of the nettle, but never so venomous; its leaves are oblong, pointed, hairy, and deeply serrated; and its flowers come out alternately on short trifid footstalks, are somewhat deeply cut into many acute segments, enjoy the same kind of reputation for double conformation, with both white and blue colours, as those of the peach-leaved bellflower, and usually bloom during July and August. The double varieties are easily propagated by dividing the roots.

The pyramidal bellflower, *Campanula pyramidalis*, is a native of Carniola, and was introduced

to Great Britain toward the close of the 16th century. It is perennial rooted, usually grows to the height of about four feet, and has long been regarded as eminently ornamental. Its root is thick, tuberous, and milky; three or four stems usually rise from one root, and are strong, smooth, upright, and garnished with smooth, oblong leaves, whose edges are a little indented; and its flowers are large, open, and bell-shaped, and are produced from the side of the stems, over more than one half of their length, so as to form a sort of floral pyramid. One variety carries white flowers, and another pale blue flowers; and the latter is by far the most esteemed. This plant is cultivated to adorn halls, and to be placed, while in flower, before chimneys; and it is better adapted for these purposes than any other flowering herb; for when its root is strong, four or five stems rise from it to the height of four or five feet, sending out flowering side-branches, and capable, along with these branches, of being spread out like a huge fan upon a frame of slender sticks, there to produce an absolute sheet of flowers so large as to screen the whole face of a chimney. If kept from rain and sunshine, the flowers continue long in beauty; but a plant treated in this manner is seldom in good condition in a second season, and requires to be succeeded by a new plant. Propagation is easily and rapidly effected from offsets; but, if first-rate plants are wanted, they must be raised from seeds.

Another well known and commonly cultivated species is that called Canterbury bells, *Campanula media*. It is biennial, and of various height, and includes several varieties, particularly a deep blue and a snowy white; and its flowers, though somewhat coarse in texture, are large in size and very beautiful in form.—The best known annual kinds, including that which is popularly known as Venus' Looking-Glass, now belong to the genus *Prismatocarpus*.—A very common and popularly admired species is the clustered bellflower, *Campanula glomerata*. It is a perennial, and a native of the chalky soils of England; it grows variously to the height of one foot and two feet; and it has its name from its carrying small heads or clusters of bell-shaped flowers on long naked footstalks, from the upper part of the stem. The normal plant has violet flowers; but varieties have long been cultivated with white and double white flowers; and several hybrids are now in cultivation,—particularly four, called the tall white, the pale flowered, the lilac flowered, and the tall blue.—The other species which are at present most common in gardens—all hardy and perennial—are those designated *grandiflora*, *cenesia*, *grandis*, *bellardi*, *pulla*, *sarmatica*, *pumila*, and *pubescens*.

BELLIS. See DAISY.

BELL-WETHER. A sheep which has a bell on its neck, and which leads the flock.

BELLY. The abdomen. A wound in the belly of a cow or other domestic animal, is sometimes a very serious accident. See the article WOUNDS.

BELT. A stripe or compound line of trees, planted for the purposes of shelter or ornament. A narrow belt, not more than a few yards wide, or such as does not shut out the exterior landscape, is usually very deficient in both beauty and utility; but a broad belt, while occupying more ground and occasioning more original expense, is far more than proportionably better, at once in improving the climate, embellishing the landscape, and yielding ulterior profit. See the article **PLANTATION**.

BENJAMIN-TREE. Any tree which is supposed to abound in benzoic acid, or to yield the gum benzoin of commerce. The name benjamin-tree is a popular corruption of benzoin-tree; and, besides having a loose and somewhat general meaning, is fixedly applied to three plants of respectively the laurel, the storax, and the fig-tree genera.

The laurel benjamin-tree, *Laurus benzoin*, is the one which has longest borne the name; and was at one time, though very erroneously, supposed to exude all the benzoin which found its way to the shops of druggists. It is a hardy, deciduous shrub, of usually about 8 feet in extreme height; and it is a native of North America, and was introduced to Great Britain in the last quarter of the 17th century. It grows to rather a large size, and has a greater number of branches than the deciduous bay; its branches are smooth, and of a fine light green colour; its leaves are acutely oval, nearly four inches in length and two in breadth, their upper surface smooth and light green, their under surface venose and whitish, and, when bruised, they emit a fine fragrance; and its flowers are small, yellowish green, and inconspicuous, coming out in little clusters from the sides of the branches, and blooming in April and May. This plant falsely ranks as medicinal, but deserves attention as an ornamental shrub.

The storax benjamin-tree, *Styrax benzoin*, is a native of the East Indian Islands, and particularly abounds in Sumatra. It is a moderately-sized tree; and is now supposed by most writers to yield all or at least most of the benzoin of commerce. Its stem is much ramified, and is never used for timber; its branches are round, and covered with a whitish downy bark; its leaves are alternate, oblong, and entire, smooth above, woolly below, and yield a strong turpentine odour; and its flowers are produced in compound axillary clusters, nearly as long as the leaves. This tree yields benzoin through artificial incisions in the bark near the lowest ramifications of the trunk; and each tree is annually subjected to incisions from its seventh to about its eighteenth year, and annually produces about three pounds of benzoin.

The fig benjamin-tree, *Ficus benamina*, has but an accidental association of popular name with the other benjamin trees. It is an ornamental evergreen small tree, requiring hothouse

culture; it has smooth leaves, and usually grows to the height of about 10 feet; and it is a native of the East Indies, and was introduced to Great Britain about the middle of last century.

BENNET (HERB). See **AVENS**.

BENNET (WY). See **BARLEY**.

BENT. See **AGROSTIS**.

BENTHAMIA. A recently introduced and very beautiful, hardy, evergreen shrub, of the dogwood tribe. Loudon, in his *Gardener's Magazine*, speaks of it with enthusiasm, and says,—“We want words to express our admiration of this shrub. Beautiful as it is, it is so easy of propagation, that it will soon be in every cottage garden.” Only one species, *Benthamia fragifera*, is yet known; and this was introduced from the East Indies in 1825, and given out for propagation and diffusion in 1833. “The general observer,” says Loudon, “may form an idea of it, by imagining *Cornus florida* covered with the flowers of *Stuartia Malachodendron*, and the fruit of *Arbutus unedo*—but rather larger.” The first plant of it grown in Europe was raised at St. Austle in Cornwall; it grew in the open ground, in stiff clay, at a comparatively great elevation, without even the slightest protection; and in 1833, it had a height of 16 feet, and was covered with fruit. The leaves of the *Benthamia* resemble those of *Cornus mascula*, but are more elegant; its involucral leaves, which first defend and afterwards garnish the heads of its flowers, are large and showy; its flowers are of a yellowish colour, and bloom during summer; and its heads of ripened fruit are orbicular, depressed, more than one inch across, of a tawny red, and on a peduncle 3 inches in length. A bush studded with the fruit, partly pendulous by their weight, abounding in neat green glossy leaves, and enjoying the mellow sheen of autumn, is a very lovely object, and will be a superb decoration of the home-plots of farmeries, and the mimic lawns of the better class of cottages. It grows either from seed in the open ground, or from a cutting under a hand-glass. It was named in honour of George Bentham, Esq., secretary to the London Horticultural Society.

BENZOIN. A substance of a nature intermediate between a resin and a balsam. It is popularly but improperly called a gum. The benzoin of commerce is obtained wholly or at least principally from the storax benjamin-tree; and is brought to Great Britain in large masses, packed in chests and casks. It has a very agreeable fragrant odour; and is used by the Malays and the Roman Catholics, in their public religious ceremonies, as an altar perfume. The best kind of it consists of 80·08 per cent. of resin, 19·80 of benzoic acid, 0·12 of moisture, and a trace of volatile oil. It is administered for asthmas and other pulmonary affections by the Tamul physicians, and was formerly used for the same purposes by the physicians of Great Britain; but it is now employed in this country, only for prepar-

ing benzoic acid, and for the perfuming of Roman Catholic chapels.

Benzoic acid, as obtained by the combustion of benzoin, is a white smoke, easily condensable into a white flocculent mass, and is popularly called the flowers of benzoin. It consists of 15 equivalents of carbon, 3 of oxygen, and 6 of hydrogen. It exists naturally in the leaves and culms of sweet-scented vernal grass and sweet-scented soft grass, and in the flowers of the officinal melilot,—*Anthoxanthum odoratum*, *Holcus odoratus*, and *Melilotus officinalis*; it appears to be the principle which gives these plants their pleasant odour, and occasions most of the delightful fragrance of pasture and hay; and it passes undecomposed from these plants, to be a considerable element in the urine of cows and other herbivorous animals. It has been detected also in the urine of children. But though so prominently connected with the agreeable odours of agriculture, it seems to have little connexion with its uses. Nor is it much used in medicine, except as an ingredient in one or two tinctures.

BERBERIS, or BERBERRY. See BARBERRY.

BERE. See BARLEY.

BERGAMOT. A variety of pear, called in French bergamotte, and in vulgar English bergamy. The name is said to be of Turkish origin, and to signify 'the chief of pears.'—Bergamot is also a perennial, herbaceous, aquatic ornamental plant, of the mint genus, sometimes called *Mentha odorata*, and sometimes *Mentha citrata*. It grows wild in watery places in England, attains a height of about a foot, and carries a purple flower in July and August.—Bergamot is likewise the essential oil of the rind of the bergamot orange, or lemon bergamot orange, sometimes called *Citrus bergamium*, but more properly *Citrus limetta*. The tree is an evergreen, and usually not more than 8 or 10 feet in height; its leaves have an oblong, pointed form, and are pale on their under surface; its flowers are small and white, and bloom from May till July; and its fruit is pyriform, has a pale yellow colour, and contains a slightly acidulous pulp. The oil is obtained by pressure and distillation of the rind, and is usually called the essence of bergamot. It is one of the sweetest and best known of perfumes, has a pale greenish colour, is lighter than water, possesses considerable resemblance of odour to the essential oil of lemons, and is very generally sold in a state of great dilution with alcohol.

BERRY. See BACCIFEROUS PLANTS.

BERRYBEARING ALDER. See ALDER.

BETA. See BEET.

BETHLEHEM (STAR OF). See ORNITHOGALUM.

BETLE, or BETEL,—botanically *Piper betel*. A tender evergreen shrub, of the pepper genus. It is extensively cultivated in eastern countries, and was introduced to Great Britain from the East Indies in 1804. It usually grows to the height of about six feet. Its leaf contains a powerfully stimulating and even intoxicating principle, and

is chewed in most eastern countries in the same manner in which low and dirty Europeans chew tobacco. The juice of the leaf, too, is prescribed by the Vytians as a febrifuge for adults, and as a remedy for indigestion in children; and it is likewise given, in conjunction with musk, in cases of hysteria.

BETON. See CONCRETE.

BETONY,—botanically *Betonica*. A genus of pretty, hardy, perennial, herbaceous plants, of the labiate tribe. One species is indigenous in Great Britain; eight or nine species have been introduced from foreign countries,—principally continental Europe; and three or four other species are known to botanists. The genus is so nearly allied to *Stachys* or hedge-nettle, as to be identified with it in some modern botanical systems; yet it is sufficiently distinct to be worthy of retaining its own ancient name.—The common or medicinal betony, *Betonica officinalis*, grows wild in almost all woods, thickets, and shady grounds in England. Its stem is dark-coloured, hairy, and almost naked, and usually attains the height of about a foot; its leaves grow numerous from the crown of the root, and are about an inch in length, comparatively broad, dark green, hairy, and serrated; and its flowers are small, similar in shape to those of mint, usually purple, but sometimes crimson, and sometimes yellowish, and bloom in July and August. The whole plant, cut immediately before the time of flowering, and dried in the open air, was formerly in high repute among herbalists as a tonic and a general strengthener of the human system; and the favourite mode of using it was in infusion as a tea. The fine stiff hairs which cover it cause it, when powdered, to provoke sneezing, and occasion it to be a common ingredient in herb snuffs. The other species of betony rank as ornamental plants, yet are scarcely worthy of notice.—Betony is also the name of a small, ornamental, half-tender, evergreen, under shrub, of the germander genus, from Madeira, *Teucrium betonicum*.

BETULA. See BIRCH.

BEVERAGE. Any liquid which is used as an agreeable and ordinary drink. The word is derived from an obsolete verb *bever* 'to drink.'

BEZOARS. Concretions or stony substances found in the intestines and other parts of land animals. They occur principally in ruminating animals, less frequently in other herbivorous animals, and occasionally though rarely in human subjects who subsist almost wholly upon vegetable and especially farinaceous food. They are supposed to be formed by agglutination of some of the elements of food, upon minute nuclei or hair or wool, by the secretions of the intestinal canal; they do not seem to occasion any disastrous symptoms or even any serious inconveniences, yet cannot but be regarded as indicative of disease; and they are very far from being uniformly found in all the individuals of any one species of animal, subsisting together on the same

kind of food. They were formerly viewed, in every country, as antidotes to all poisons, and as possessed of some other extraordinary virtues; they were, in some instances, so highly prized, as to be sold for ten times their weight of gold; they gave rise to the adjective bezoardic, as an epithet of any sort of object which was thought superlatively valuable; and they were extensively counterfeited by artificial preparations, exactly as gold coins and precious gems are counterfeited by base imitations; and yet they owed all their original interest to their rarity and the singular manner of their formation, and all their market value to the place which they acquired in popular caprice. They are still esteemed in the east; but, except as a sheer disease, they have passed into utter oblivion in Europe. They seem to have been first used as a medicine by the Arabians; and they continue to be imported into India from Ceylon, Bassora, and the sea-ports of the Persian gulf. The variety of them held in highest esteem, and called emphatically *Lapis bezoar orientalis*, is found in the stomach of the wild-goat of Persia. The variety obtained from the west, and known as American bezoars, are found principally in the different species of the llama. See the article ALPACA. A variety, much less indurated than the eastern and western kinds, is not uncommon in our sheep, and very frequent in our lambs; but is seldom found at any other time than the months of September and October, and does not appear to be injurious to health. Clater describes them as "a number of small balls, often of the shape of an almond, or resembling that of the stomach itself;" and adds,— "They are usually of a brown colour, but sometimes inclining to a yellow. On cutting them with a knife, they appear to be composed of layers consisting of wool, intermixed with earthy substance and mucus. They can be dissolved by means of boiling water, and in all probability by the gastric juice of the stomach; as, though they are common in the autumn, they are rarely found a few months later." The hard stony bezoar of the east is believed to consist principally of phosphate of lime. See the article CALCULUS.

BIENNIAL PLANTS. Plants which fructify and perish in the second season of their existence,—rising from seed in one year, and flowering, seeding, and dying in the next. Familiar examples of biennials are celery, the carrot, and the swedish turnip. But a very large proportion of biennials are capable of being thrown out of their biennial habit by excess of either heat or cold; some annuals are capable of being prolonged into biennials; two or three plants of usually long existence are capable of true classification with biennials; and a considerable number of the briefer-lived perennials, are commonly, though quite illogically, classed with biennials. A monocarpous plant is one which seeds only once, or which perishes from the effects of a single seeding; every monocarpous plant which seeds and

dies in the same season in which it is sown, is an annual; and any monocarpous plant which lives through a winter before seeding is a biennial. Hence in one sowing of turnips, some of the plants are annual, and most are biennial; wheat sown in spring is annual, and wheat sown in autumn is biennial; some stock sown early in spring is annual, and the same stock sown in summer is biennial; any ordinary biennial, prolonged by coldness of climate, through two or more winters before seeding, is still a biennial; and the American aloe, whether flowering in its fourth year in the most genial parts of its native country, or not flowering till its fortieth or fiftieth year in Great Britain, is technically a true biennial. But plants which flower and seed more than once, no matter how visibly they degenerate, or in how few years they decay, such as wall-flowers and hollyhocks, cannot without great confusion of idea be classed otherwise than as perennials. Most true biennials form and strengthen their roots and root-leaves during the first season, pause in growth during winter, and vigorously send up their flowering-stem in spring.

BIGG. See BARLEY.

BIGNONIA. A large genus of elegant, ornamental plants, forming the type of the order *Bignoniaceae*. The genus will be noticed in the article TRUMPET-FLOWER. The order consists wholly of monopetalous exogens, with irregular flowers, pod-like fruit, and winged seeds; and partly of trees, but principally of climbing shrubs. Most are readily distinguished by the eye, and highly admired by taste, on account of their broad pinnated leaves, and their large and richly coloured trumpet-shaped flowers. Most are natives of the tropics; and only a few grow naturally within the temperate latitudes. The timber of some is very hard, and is said to resist the attacks of worms. The most interesting genera are bignonia, catalpa, and eccremocarpus; and the other genera are chilopsis, tecoma, jacaranda, spathodea, amphibium, calampelis, fieldia, and streptocarpus.

BILBERRY. See WHORTLEBERRY.

BILE. A yellowish-green liquid substance, of a bitter taste. Man and many animals have, on the inferior surface of the liver, a peculiar bladder, in which the bile, formed by the liver from the blood, is preserved. It consists of water and several other substances. The water constitutes the greatest part, and keeps the other parts in a state of solution. The remaining ingredients are a yellow, very bitter, fusible resin, which contributes most to the taste of the bile; a small portion of natron; some mineral alkaline salts; some oxyde of iron; a small quantity of a yellowish substance, which is only partly dissolved in the natron; and a considerable portion of albumen. Thenard and Berzelius have done much to determine the ingredients of the bile. Its principal use seems to be, to separate the excrement from the chyle, after both have been formed, and to

produce the evacuation of the excrement from the body. It is probable that these substances would remain mixed together, and they would, perhaps, even be partly absorbed together, were it not for the bile, which seems to combine with the excrement, and, by this combination, to facilitate its separation from the chyle, and thus to prevent its absorption. Fourcroy supposes that the bile, as soon as it is mixed with the contents of the intestinal canal, suffers a decomposition; that its alkali and saline ingredients combine with the chyle, and render it more liquid, while its albumen and resin combine with the excrementitious matters, and gradually render them less fluid. From the late experiments of Berzelius on *feces*, it cannot be doubted that the constituents of the bile are to be found in the excrementitious matter; so that the ingenious theory of Fourcroy is so far probable. The bile also stimulates the intestinal canal, and causes it to evacuate its contents sooner than it otherwise would do; for when there is a deficiency of bile, the body is constantly costive. Biliary calculi, or gall-stones, are sometimes found in the gall-bladders of men and animals. See the article CALCULUS.

BILL. An edged tool used for lopping hedges, pruning shrubs, cutting bushes, and some other purposes. It is a kind of hatchet, with a hooked point, and has a shorter or a longer handle according to the particular purpose for which it is employed. It takes its name from the resemblance of its point to the bill of a bird.

BILLARDIERA. See APPLE-BERRY.

BILL OF EXCHANGE. A written request or order to one person to pay a certain sum of money to another, or to his order, at all events; that is, without any qualification or condition. The person who makes the bill is called the *drawer*; the person to whom it is addressed, the *drawee*; and the person to whom, or whose order, on the face of the bill, it is payable, the *payee*. If the drawee accepts the bill, he thereby becomes the *acceptor*. A *promissory note* differs from a *bill of exchange* in being merely a promise to pay money by the maker, instead of being a request to another person to pay it, to the payee. The expression *promissory note* is not strictly confined to negotiable notes, or those payable to 'bearer,' or to the payee named in it, 'or his order,' but is more frequently used to denote such instruments; and we shall consider promissory notes in this sense in the present article, since the same rules and principles are, in a great degree, applicable to such notes and to bills of exchange. The maker of the note answers to the acceptor of the bill, since he is the party promising to pay it; whereas the maker or drawer of a bill of exchange does not directly promise, on the face of the instrument, to pay it, but merely requests the drawee to do so; this is, however, construed to be a virtual promise that the drawee, on the presentment of the bill for acceptance, and de-

mand of payment according to its tenor, will pay it, and a conditional virtual promise, that he, the drawer, will pay it, in case of the drawee's failing either to accept it on due presentment, or to pay it on due demand. *Bank checks* are of a character similar to promissory negotiable notes, as to the rules by which the liabilities and rights of the parties to them are determined, with this difference in their common form, that promissory notes are usually made payable to the payee or 'his order,' whereas checks, as also bank-notes, are usually made payable to the 'bearer,' and the right to demand and receive payment of them is transferred from one person to another by mere delivery, without any indorsement or written order by the original payee; while the transfer or assignment of a promissory note or bill of exchange is made by the payee in writing, either by indorsement or otherwise. He usually merely writes his name on the back, whereby he becomes the *indorser*, and the person to whom it is thus indorsed or assigned, who is called the *indorsee*, has a right to fill up this blank indorsement by writing over it an order to pay the contents to himself or to any other person; and any *bona fide* holder of the note or bill has the same right to fill up the indorsement or assignment. Thus a note or bill of exchange, being once indorsed in blank, becomes assignable or transferable, like a check payable to 'bearer,' merely by delivery of the instrument. It is an essential quality of a negotiable bill, note or check, that it be a promise to pay a certain sum of money, and that the promise be absolute; for if no definite amount is fixed, or it be a promise to deliver goods or do any other act than pay money, or if it be conditional, it is not a bill of exchange, or negotiable promissory note, or check. Besides the transfer by indorsement above-mentioned, these instruments are also transferable by assignment, or mere delivery, so as to give the holder all the rights, against the maker or acceptor, that he would have had if he had himself been the payee. Where the transfer is made by mere delivery, the assignor is exempt from all liability to the holder on the paper itself; he makes no promise to pay the money, but still he, in effect, warrants that it is the bill, note or check, which it purports to be; for if it be a forged instrument, if it be not *bona fide* the bill, note or check which it purports to be, he will be liable to indemnify the person to whom he transferred it. But if the transfer be made by an indorsement in writing, without any condition or exception, being an absolute order to pay the money to the indorsee or holder, the indorser in this case becomes in his turn a promiser; for he thereby virtually promises that, in case the maker of the note or check, or the drawer or acceptor of the bill, does not pay it on due demand, or in case the drawee does not accept it, if it be a bill, on presentment according to its tenor, then he, the indorser, will pay it.—Though the forms of bills of exchange, promis-

sory notes, checks and bank-notes are, respectively, pretty uniform, yet no precise form of words is necessary to constitute either of these instruments. Any words, purporting to be an absolute promise to pay a certain sum of money, or an absolute order for its payment to a particular person or his order, or to the bearer, is either a bill of exchange, promissory note, or check.

Bills of exchange are, in England, either inland, that is, payable in the kingdom, or foreign, that is, payable out of the kingdom. A similar distinction is made in the United States, where, in most of the states, a bill payable in the state in which it is made is considered to be inland. The material distinction between foreign and inland bills is, that, on inland bills, a protest for non-acceptance or non-payment is not usually necessary, and that less damages can be claimed in consequence of the dishonour of the bill, if, indeed, any can be claimed. Generally, in fact, if not universally, only the face of the bill can, in such case, be recovered of the drawer or indorser. In one respect, foreign bills most generally, and inland bills and promissory notes in many places, differ in construction from the literal import of the terms of the instrument as to the credit or time of payment, being, in fact, payable three days after the time specified; these three days of additional credit being allowed under the name of *grace*: but this additional credit is often expressed in the instrument itself, thus,—"Pay to A. B. or order, in sixty days and *grace*," which is equivalent to sixty-three days. Another mode of expression for the credit to be allowed on a bill is by the word *usance*. Thus a bill is drawn payable at one or two *usances*; and it is necessary, in order to ascertain the time of payment, to know what period is meant by a *usance*, and this will vary according to the place at which, and on which, the bill is drawn. Thus a bill drawn in England, at one *usance*, on Amsterdam, Rotterdam, Altona, or any place in France, is payable in one calendar month from the date; on Cadiz, Madrid, or Bilboa, in two; on Genoa, Leghorn, or Venice, in three months.—If, on presentment of a bill of exchange to the drawee, he refuses to accept it according to its tenor, the holder has an *immediate* cause of action against the drawer and indorsers, and may, on giving them notice of the non-acceptance, forthwith demand the amount of the bill, though it was on a long credit, and, if it had been accepted, he must have waited three or six months for his money. This rule is perfectly equitable, since the drawer and indorsers impliedly agree that the draft shall be accepted on presentment, and, on its not being so, their promise is violated. But the holder must give notice to the drawer, and the other parties to whom he wishes to resort, of the non-acceptance or non-payment of the bill. In case of the dishonour of a bill, the holder has generally the right to recover of the

parties liable to him, that is, the drawer and indorsers, not only the amount expressed on the face of the bill, together with the expenses of protest and interest, but something in addition, on account of his disappointment in not having funds at the place on which the bill is drawn, as he had a right to expect. The rate or amount of this damage must, as is evident, be very various, according to the distance of the places, the credit on which the bill was drawn (in case of protest for non-acceptance), and the rise or fall of exchange on the same place after the purchase of the bill. One rule of estimating the damage is the cost of re-exchange, or of another bill on the same place, with the addition of one, two, &c., up to twenty per cent. damages. In other places, no regard is had to re-exchange, but the holder recovers a certain per cent. over the face of the bill, by way of damage, and this rate is the same whether exchange may have risen or fallen from the time of purchasing the bill to that of its being returned dishonoured.

Exchange appears to have been known anciently at Tyre, Carthage, Athens, Corinth, Syracuse, and Alexandria. The first well-ascertained traces of it, in modern times, are found, subsequently to the 12th century, in some of the provinces of France, particularly at the fair of Champagne. It was brought to perfection in Italy. Its great utility and convenience consist in its negotiability. Suppose, for instance, a number of persons to have, severally, sums of money deposited in various countries. One, whose funds are in South America, wishes to make purchases at St. Petersburg; and one, who is entitled to the proceeds of a cargo at St. Petersburg, wishes to make a purchase at Canton; and another, having funds at Canton, desires to make an importation from South America. By merely making and delivering a slip of paper, each one will, in effect, transfer his funds quite across the globe. Another advantage of exchange is the facility it affords in adjusting balances. Its effect in this respect may be illustrated by the practice of banks and bankers in some particular cities. In London, for instance, the bankers meet at a certain hour every day, to pay and receive payment of each other's checks; but the amount actually paid will bear a very small proportion to the whole amount of the checks, since the greater part is settled by merely cancelling the checks they hold against each other. So where all the banks of a city, as is the practice in many commercial towns, take indiscriminately each other's notes, and settle the balances every day, they all make an exchange of the notes which they hold against each other, and only pay over in specie the balances. Thus, by the payment in specie of a comparatively very small sum, some hundreds of thousands may circulate between these institutions and their respective customers and depositors. In the same manner the balances are adjusted between two commercial countries, or all

the commercial countries of the world. Among the various merchants of the United States, for instance, some have sent goods to England, others to France, and others to Holland, and each one may wish to import goods from a country other than that where his funds lie. One, accordingly, sells exchange on Amsterdam, and buys exchange on London, or, which is the same thing in effect, as far as he is concerned, he orders his correspondent at Amsterdam to buy exchange on London, and remit it thither for his (the merchant's) account. If the funds which some merchants have in each foreign place are exactly equal to what is wanted by others in the same place, the whole transaction is only a transfer among themselves of each other's claims, or exchange, and no balance remains; whereas, without this facility, one must order specie home from Amsterdam, which the other would purchase of him to ship it to London; a transaction involving much delay, besides the expense of freight and insurance. But still, all the merchants of the country may wish to invest or pay greater sums abroad than the proceeds of all the exports already made or making from the country amount to, in which case the course of exchange is said to be against the country, and, in this case, as in all others where the quantity of an article wanted is greater than that offered in the market, the price will rise, and foreign exchange will be above par. So, if the quantity of exchange demanded on any particular country is greater than that offered, the rate of exchange, in respect to that particular country, is unfavourable, and rises. This has most generally been the case in the United States, in respect to England. So, *vice versa*, if the funds belonging to Americans, in any particular foreign country, are greater than the sum wanted by other Americans to make payments or investments there, the rate of exchange with that particular country is favourable, and the price of it falls. And it is to be observed, that what is called a *favourable* rate of exchange is, in fact, *unfavourable* to the person having funds abroad, who wishes to realize them at home; for he must, in that case, sell, at home, his foreign exchange, for a smaller sum than its nominal amount. It is to be borne in mind, therefore, that an unfavourable rate of exchange is not necessarily disadvantageous to a country. To follow out the inquiry, and determine in what circumstances it is actually disadvantageous or indifferent, or in fact advantageous, would occupy more space than we can give to the subject. But we perceive from this operation of the system of exchange, that it is only necessary, at most, to ship abroad, or import from abroad, in specie, the actual balance on the whole aggregate of debts and credits, all the items of which, as far as they offset each other, are adjusted by exchange; and it is by no means always the case that this aggregate balance is paid in specie; for the very circumstance of the rise of exchange on any particular country

may make the trade more favourable, and induce shipments, the proceeds of which are drawn for as soon as the shipments are made; so that, in such a case, the unfavourable balance may be actually advantageous, by promoting trade.

BILL OF LADING. A memorandum signed by masters of ships, acknowledging the receipt of goods intrusted to them for transportation. There are usually triplicate copies, one for the party sending, another for the party to whom the goods are sent, and the third for the captain.

BIN, or BINN. A coarse fixed box, or structure resembling a large open chest, or crib, for holding corn or other agricultural produce. The corn-bin of the stable contains grain or other provender for the supply of the horses; the yard-bin contains straw or other bulky fodder for the supply of the animals of the farm-yard; and bins of other forms contain hops, bottled wine, or other matters, and are called hop-bins, wine-bins, &c.

BINDWEED, — botanically *Convolvulus*. A large genus of very interesting herbaceous plants, forming the type of the order Convolvulaceæ. The genera of this order are Retzia, Convolvulus, Ipomœa, Cressa, Cuscuta, Dichondra, Evolvulus, Dinetus, Argyreia, Calystegia, Porana, Morenoa, and Falkia. A few are shrubs, many are annuals, most are twining plants or literally bindweeds, several are highly medicinal plants, and a large proportion are highly ornamental, with handsome, showy flowers, which expand beneath a play of sunshine. Such as grow among agricultural crops have creeping roots or climbing stems, and are very difficult of extirpation. Scammony, jalap, and other drugs, are products of convolvulaceæ; and several stimulating, and two kinds of eatable roots, one of the latter the sweet potato of America and the south of Europe, belong to the genus Ipomœa.

A considerable number of species formerly belonging to the genus Convolvulus have been assigned by modern botanists to the genera Ipomœa and Calystegia, and must still be regarded as strictly bindweeds. The number of species still regarded by all botanists as true convolvuli, is about 200; and of these, one grows wild as a troublesome weed in Great Britain, one is a medicinal plant, and nearly sixty are cultivated in British gardens, a few as curiosities, but most as elegant flowering plants. One of those grown in Britain is a biennial; eleven are annuals; and the others are variously hardy, greenhouse, or stove perennials. We can afford to take special notice of only a few of the most interesting or best known.

The corn-field bindweed, *Convolvulus arvensis*, is a perennial twiner, has usually a flesh-coloured flower, blooms from June till September, and generally attains a height of about 18 inches. It is variously called withwind, gravel bindweed, smaller field bindweed, and devil's guts; and, in spite of possessing much beauty, is abhorred by both farmers and gardeners for its great annoy-

ance as a weed. It very frequently occurs on gravelly lands and on all sorts of dry soil, whether light or heavy; and is usually an indication that a stratum of gravel lies under the surface. Its root is creeping and ramified, and strikes very deep; its stems are numerous and weak, trailing along the ground, and twisting themselves round neighbouring plants; its leaves are triangular and arrow-pointed; and its flowers are produced from the side of the branches, each on the top of a long footstalk, and they have a fragrance like the flowers of the heliotrope, but fainter, and display great diversity of delicate tinting, from almost pure white, through all the shades of flesh-colour, to the most beautiful pink, with yellowish plaits and stains of crimson. An enthusiastic florist admiring these exquisite flowers, as he detects some among any crop of the kitchen-garden, and a plodding operative gardener gazing on the same flowers as the production of one of the most stubborn weeds with which he has to contend, display a most ludicrous contrast of attitude and expression, and might form not a bad subject for the pencil of a comic painter. This plant is indeed an excessive pest to both gardener and farmer,—especially to the latter; and seems to have received its strange name of devil's guts from its power of tormenting. Mr. Lisle, after observing that he believes it to propagate itself in pasture ground chiefly by its roots, and in arable land by its seeds, assigns as a reason why it is most apt to multiply in strong clayey soils, that these are usually ploughed in winter or not earlier than spring, and, so far from being cleansed as if ploughed in summer fallow, suffer an absolute multiplication of the bindweed from the stirring and separating of its roots and offsets. "I have known in this case," says he, "clay land folded for barley, and particularly that part of it which, waiting for the folds going over it last, was latest fallowed, bring up so great an increase of withwind, that, though the spring and summer had been very dry, every stem of barley had a withwind round it. As the field brought up a crop of this corn, it brought up with each plant its enemy, which would eat it out, pull it down before it could ripen, and thereby prevent the filling of the grain. The crop is also greatly hazarded here, after it is out, by the danger it must run by being in swarth till this weed is withered, before it can be carted. Again, near the end of the first summer, after the first year of a crop of hop-clover, which I fed, that is about the beginning of August, I fallowed a ground for wheat, then dunged the fallows, and sowed my wheat before Michaelmas. I had a very good crop of wheat; but a withwind came up to every plant; so that had it been a wet and cold summer, instead of a hot and dry one as it chanced to be, my corn would have been pulled down and lodged, while green in the ear, and in the milk, and could not then have filled in body and flour, but must have been of the nature of blighted

corn. The increase of the withwind here was, without doubt, occasioned by the laying down this ground only to one summer-seed after the hop clover was sown, when it had borne three or four crops of summer corn after its wheat crop; for by the winter ploughings, the offsets of the roots of weeds, and their seeds, were propagated. I could not conveniently destroy these roots or seeds by giving the ground a seasonable summer-fallow in the beginning of June, because I should then have lost the fruits of my hop clover crop, by ploughing it in at the beginning of the first summer; though this would have contributed much to the killing of the withwind; whereas by delaying the fallowing three months longer, to the beginning of August, when the sun had lost its strength to burn up the roots and mull the seeds, and it was too late for the ground to lie long to a fallow, the dung laid on the fallows gave new life to the roots and seeds."

The scammony bindweed, *Convolvulus scammonia*, is a hardy twining perennial, and was introduced to Great Britain from the Levant, towards the close of the 16th century. It is a native of Syria, Mysia, Cappadocia, and Cochin China, and is particularly abundant on the mountains between Aleppo and Latachea. Its root is tapering, three or four feet in length, from three to four inches in diameter, covered with a light grey bark, and contains a milky juice; its stems are slender, numerous, and from 15 to 20 feet in length; its leaves are smooth, arrow-shaped, and bright green, and stand upon long footstalks; and its flowers are yellow, white, or purple, and funnel-shaped, stand in pairs upon pedicles, and bloom in July and August. The powerfully drastic purgative drug called scammony, or resinous gum scammony, and used by druggists as an ingredient in some of their pills, is obtained from the roots of this plant, and imported principally from Syria.—Both the jalap and the sweet potato bindweeds, *Convolvulus jalapa* and *Convolvulus batatas*, the former producing the well known jalap of the drug shops, and the roots of the latter constituting the well known sweet potato, rank in modern times as ipomœas. See the article IPOMŒA.

The great hedge bindweed or bearbind, formerly called *Convolvulus sepium*, but now usually called *Calystegia sepium*, is a perennial twining weed of Great Britain, beautiful for its flowers, but annoying for its weedy and twining habit. Its roots are long, rather fleshy, and extensively creeping; its stems are smooth, leafy, and somewhat branched, and grow usually to the height of about 6 feet, but sometimes to the height of 10 or 12; its leaves are arrow-shaped, and seem as if torn at the base; and its flowers are large, solitary, and white, and flourish from June till September. A variety, called *Calystegia sepium incarnata*, has reddish flowers of an uniform flesh or rose colour. The great hedge bindweed grows luxuriantly at the bottom of moist hedges, in osier holts, in wet

thickets, and in other similar places where it cannot easily be reached; but when it appears, as it too often does, on open, clear pieces of ground, it may be effectually destroyed by sedulous hoeing through a period of three or four months; for when its stems are broken, a milky juice flows out, and occasions the root to become exhausted and to die.

The soldanella, or sea bindweed, or sea bearbind, formerly called *Convolvulus soldanella*, but now usually called *Calystegia soldanella*, is an evergreen perennial of the sea beaches of many parts of England. Its roots are white, stringy, numerous, and extensively creeping; its stems or weak trailing branches, are round, purplish green, and from one foot to two feet long, and twine around neighbouring plants in the same manner as common bindweed; its leaves are alternate, kidney-shaped, and about the size of those of the lesser celandine, and stand on long footstalks; and its flowers are somewhat bell-shaped, comparatively large, very beautiful, of a delicate purplish pink with pale yellow streaks, standing on long solitary footstalks, appearing in June and July, and expanding only in the sunshine. When either the stem or the root is broken, a milky juice exudes. Herbalists and old practitioners used this plant, under the name of soldanella or sea brassica, as a brisk purgative for the cure of dropsy and rheumatism. The general method of exhibition was a decoction of the whole of the fresh plant, with a few cloves, in ale or beer; but the purging action resembles that from scammony, and is much too violent for persons in bad health or of a weak constitution. The juice, if collected, and allowed to exsiccate, hardens into a substance resembling scammony.

The Canary bindweed, *Convolvulus canariensis*, is a tender evergreen twiner. It grows naturally in the Canary Islands, and was introduced to Great Britain near the end of the 17th century. Its root is strong and fibrous; its stems are woody and twining, and divide into smaller stems which, if supported, rise to the height of 20 feet; its leaves are soft, hairy, and oblong heart-shaped; and its flowers are produced from the wings of the leaves, stand solitarily upon footstalks, are usually of a purple or pale blue colour, but in one variety are white, and bloom from May till September. This plant, in consequence of its having green leaves throughout the year, is a charming winter inhabitant of the greenhouse; but though it needs only the same protection as a myrtle, it will not live in the open air. It may be propagated from either seeds, cuttings, or layers.

The beautiful blue-margined annual bindweed, usually though improperly called *Convolvulus Minor*, and even its white-flowered variety, often but improperly called *Convolvulus Alba*,—these plants, the *Convolvulus tricolor* and the *Convolvulus tricolor albiflorus* of botanists—are so very generally known amongst even cottage florists,

as to need no description.—The great annual purple bindweed, and its flesh-coloured, variegated, and white-flowered varieties, are also well known under the erroneous name of *Convolvulus major*; they were formerly designated by botanists *Convolvulus purpurea*, but are now ranked as ipomœas; and they usually grow twiningly to the height of about 10 feet, and have a very elegant and showy appearance.—The chief of the other ornamental convolvuli at present cultivated in the gardens of Britain are the hardy annual *Convolvulus discolor*, *C. hirtus*, *C. dissectus*, *C. nil*, and *C. pentapetaloides*,—the hardy perennials *C. spithamea*, *C. althæoides*, and *C. lineatus*,—the greenhouse woody perennials, *C. cneorum*, *C. hastatus*,—and the stove perennials, *C. flagelliformis*, *C. glaber*, and *C. speciosus*.—*Miller's Dictionary*.—*Mawe's Calendar*.—*Loudon's Hortus Britannicus*.—*Withering's Botany*.—*Lisle's Husbandry*.—*Mill's Husbandry*.—*Thomson's Materia Medica*.

BINDWEED (ROUAN),—botanically *Smilax aspera*. A hardy, deciduous, dioecious, climbing plant, of the smilax genus. It is sometimes called prickly bindweed, and sometimes Italian smilax. It is a native of Sicily, Italy, Spain, and France, and was introduced to Europe about the middle of the 17th century. Its root is long, creeping, white, and fleshy; its stems are numerous, slender, angular, provided with claspers, and armed with strong, short, crooked spines, and, if supported, grow to the height of ten or twelve feet; its leaves are cordate, acutely pointed, indented, of a fine dark green colour, with short spines on their edges, and standing on somewhat long petioles; and its flowers are inconspicuous, grow from the wings of the stalks, and appear in June and July. A principal variety of it, *S. A. auriculata*, is distinguished by ear-shaped leaves.

BINDWITH. See CLEMATIS.

BINN. See BIN.

BIRCH,—botanically *Betula*. A genus of hardy timber and ornamental trees and shrubs, of the amentaceous tribe. It forms the type of one of the subdivisions of that tribe, comprising the genera *Betula*, *Carpinus*, *Alnus*, and *Ostrya*. This subdivision, called Betulinæ or Botulacæ, is distinguished from all other amentaceous genera by its flat, one-sided, two-celled membranous fruit, and by its pendulous ovules; and it is exceedingly well represented by the common or white birch. All the species are either trees or shrubs, and grow indigenously in only the colder parts of the world.

The birch genus comprises about nineteen species, exclusive of varieties; it occupies at once a conspicuous, an ornamental, and an useful place in the sylvæ of the northern hemisphere north of the tropics; and it is known to the popular eye by its shining bark, its neat small leaves, and its profusion of spray, and characterized to the eye of a botanist by the conformation of its fruit, vulgarly called birch seeds,—the scales being thin and three-lobed, and the fruits subtended by them

being flat and furnished with styles and thin wings. One of the species is an evergreen undershrub; five are deciduous shrubs, of from 4 to 6 feet in height; and all the others are deciduous trees of from 10 to 70 feet in height.

The common white birch, *Betula alba*, is a native of the moist woods of Great Britain; it is found in the highest latitude or limits of the growth of trees; it occurs in the south of Europe, only at a considerable elevation upon lofty mountains; and it extends eastward in Asia to the Altai mountains. Its stem attains a very various height, according to soil and climate, from that of a stunted shrub of only a few feet, to that of a fine tree of about 70 feet; its branches are erect, warted, downy when young, and never afterwards smooth; its leaves are ovate, serrated, and somewhat rhomboidal, and stand upon downy, acute footstalks; and its catkins are pendulous, and appear in April, May, and June. But it is so universally known in Britain, both as a singly growing tree, as a frequent member of woods, and as the sole constituent of many upland coppices, that it does not need to be minutely described. Though usually of humble stature, it sometimes, in favourable situations, attains a stately height; and though disesteemed as a living tree, and often put to degrading uses as timber, it is capable of being rendered eminently ornamental and not a little useful. Its form is spruce, light, and elegant; its spray is even more elegant in winter than its foliage in summer; and its stem, except in old age, has picturesque touches of brown, yellow, and silvery white, which contrast agreeably with the foliage, and are good subjects for the pencil's imitation. It flourishes on soils which are nearly barren to any other large economical vegetation; and it grows at a higher elevation on the mountains of the Scottish Highlands, than any other tree except the mountain ash. In ravines inaccessible to cattle, it flourishes at the height of upwards of 1,500 feet above sea-level; and so far from becoming deteriorated, it actually increases in value, with the altitude of its situation.

The birch does not make a compensating return on land fit for the more profitable timber trees; yet is productive on very wet or springy land, and highly remunerating on poor elevated soils; and it has been known to afford, in ten years, a return of ten pounds per acre on land so sterile as to be capable of producing nothing else but moss. It throws off a delightful odour, especially after rain or heavy dew; and a few trees of it planted near a house fill all the surrounding air with an agreeable fragrance. The gum which occasions this fragrance covers the buds in winter and spring, and abounds in the bark; it is glutinous, inflammable, and highly odoriferous; and it is extracted by the Germans and the Russians in the form of an oil, and might probably be used with great advantage, as a substitute for butter and tar, in the smearing of sheep. "The

oil," says Pallas in his *Flora Russica*, "is prepared from the white bark, either taken from the live tree, or collected from those that are putrid in the woods. It is best made from the latter, because, from the putrefaction, it is freed from the inner bark; and the external white bark remains uncorrupted for ages, as appears by the old burial-places at Jamaica, and the vaults of the very ancient castle of Moscow, which I observed were covered with birch bark. The bark is gathered into a heap, and pressed into pits made in the shape of a funnel, prepared in clay-soil; and when set on fire, it is covered with turf. The oil, distilling through the clay hole at the bottom of the funnel, drops into a vessel placed to receive it; and it is then tunned into casks made of the hollowed trunks of trees. The pure limpid oil swims at top, and is in the greatest request for anointing leather, on account of its antiseptic quality. The residuum is thick and sooty, and is employed for various common purposes." The Russians employ the oil in tanning and perfuming their leather; and the ancient Gauls appear, from a passage in Pliny, to have obtained and applied the oil in the same manner as the modern Russians. The oil is also a powerful vermifuge; and is used, in Lithuania and Courland, for curing itch and destroying vermin in cattle.

The bark of the birch contains a considerable proportion of tannin, and is sometimes peeled for the uses of the tanner; yet in the coppices of Perthshire, Stirlingshire, Dumbartonshire, and some other districts in which it abounds, it is not reckoned worth the labour of peeling. The Laplanders sufficiently tan the skins of rein-deer to render them almost impermeable by water, by cutting birch bark into small pieces, macerating these, boiling them in water with a little salt, repeatedly plunging the skins in the warm decoction, and then steeping them during several days in the decoction cooled. A very pleasing and refreshing beverage, called birch wine, is made from the sap of the birch; and the sap, for this purpose, is obtained in the same manner as that of the American maple for the manufacture of sugar.—The timber of the birch, when the tree attains considerable size, is used for gates, hurdles, articles of turnery, sleepers for railways, props for coal-pits, and various other purposes. But by far the greater portion of birch trees in England never rise above a dwarfish height, and are used principally for fuel, for the manufacture of esteemed charcoal, and for producing soot as an ingredient in printers' ink. In the bleaker districts of the Scottish Highlands, the timber of many of the houses is birch, the rude implements of husbandry are made of birch, the favourite fuel is birch, and the only skreen of the arable plots or shelter from the piercing blasts which sweep the mountains and the glens is birch; so that this tree may almost be pronounced a condition, if not of existence, at least of civilization

in these districts. The Swedes, the Norwegians, and the Finlanders find it quite as valuable as the Scottish Highlanders, and use its timber, its bark, its leaves, and its sap for a great variety of purposes,—the timber in particular, for implements of husbandry, for articles of furniture, for bowls, for plates, and for spoons,—and the bark for boxes, baskets, and sandals.

The pendulous, weeping, or lady birch, *Betula pendula*, is regarded by some botanists as a variety of the common birch, and by others as a separate species. It grows wild in Great Britain and the comparatively cool parts of Continental Europe; and has similar phytological habits and a similar height to the common birch. But its spray is longer and more slender; its foliage and lower branches are pensive like those of the weeping willow, and are put in motion by the gentlest breeze; its young branches are perfectly smooth, and have little pearly specks; its leaves are ovate, acute, and sometimes hairy; its catkins are pendulous; and altogether it is far more picturesque than the common birch, and “when agitated, is well adapted to characterize a storm, or to perform any office in landscape which is expected from the weeping willow.”—The Pontic birch, *Betula pontica*, is also regarded by some botanists as a variety of the common birch, and by others as a distinct species. It was introduced to Great Britain from Turkey, and never attains a greater height than that of a tall shrub or low tree; but in other respects, it differs from the common birch only in having a few straggling hairs on its leaves and petioles, and in possessing a portion of the drooping habit of *Betula pendula*.—Three varieties of the common birch are well-established, and usually attain the same height as the normal tree,—the warty birch, *Betula alba verrucosa*,—the Dalecarlian birch, *B. a. dalecarlica*,—and the long-fruited birch, *B. a. macrocarpa*; but the second and the third of these do not grow wild in Great Britain.

The poplar-leaved or American white birch, *Betula populifolia*, is a native of the portions of North America which extend from New Jersey to Canada, and was introduced to Great Britain about the middle of last century. It somewhat closely resembles the weeping birch, yet possesses distinct characteristics, and seldom attains a height of 30 feet. It is of very small value for its timber, and recommends itself only by the peculiar character of its foliage. Its branches are free from hairs; its stem is very much marked with resinous warts; its bark cannot be divided into laminae like that of the common birch; its leaves are triangular, and doubly serrated, and stand on long petioles; and its catkins and spray are pendulous.

The tall birch, *Betula excelsa*, abounds on cool rich soils in Nova Scotia, New Brunswick, Maine, and neighbouring districts, and was introduced to Great Britain in 1767. Its stem is straight, of nearly uniform girth, and unbranched to a

height of 30 or 40 feet; its extreme altitude is usually about 60 or 70 feet, and the girth of its stem about 6 feet; its bark has a bright golden yellow colour, and often divides into very fine stripes, which remain attached to the middle, and roll themselves backward at the ends; its young shoots and newly unfolded leaves are downy; its full-grown leaves are smooth, pointedly-ovate, sharply and irregularly serrated, and about $3\frac{1}{2}$ inches long and $2\frac{1}{2}$ inches broad; and its catkins are short, thick, erect, and nearly sessile. It exhibits a nearer resemblance to *Betula nigra* than to any other species, but is distinguished by its simply serrated leaves, and its thicker and more hairy catkins. Its young shoots, its bark, and its leaves, have an agreeable taste and odour, but lose them by drying. Its timber is inferior in both appearance and quality to that of the black birch, and is lighter coloured and less serviceable than that of the soft birch; yet it possesses considerable strength, and, when well polished, makes handsome furniture.—The yellow birch, *Betula lutea*, is very generally confounded with the tall birch; but though a native of the same regions, and closely resembling it in the remarkable and very beautiful colour of its bark, it possesses distinct characteristics, and usually attains a height of only about 20 feet.

The black birch, *Betula nigra*, is a native of the southern states of North America, and particularly abounds in Virginia; and it was introduced to Great Britain in 1736. It usually attains a height of about 60 feet. Its branches are spotted, and less numerous than those of the other species; and its leaves are comparatively broad, and grow on long footstalks, and give a sort of dignity to the appearance of the tree. Marshall, writing about 50 years ago, says, “As the black Virginian birch is naturally of upright and swift growth, and arrives at so great a magnitude, Hanbury thinks it ought to have a share among our forest trees, and to be planted for standards in open places, as well as to be joined with other trees of its own growth in plantations more immediately designed for relaxation and pleasure.” This species has been very generally confounded with the woolly, the red, the paper, the pliant, and the poplar-leaved species; and in some instances, has been pronounced a species including these as varieties. In fact, the species most commonly sold in the nurseries of Great Britain under the name of black birch or *Betula nigra* is the paper birch or *Betula papyracea*.

The woolly birch, *Betula lanulosa*, abounds in Maryland, Virginia, Georgia, and the Carolinas, and was introduced to Great Britain in 1817. It grows only on the banks of rivers, and frequently attains a height of 70 feet, with a stem-girth of from 6 to 9 feet. The shoots and branches of not more than two years old are covered with a short thick down; and the bark of the young stem and branches has a reddish or cinnamon

colour. The head or general mass of the full-grown tree is large, but, in consequence of the branches being remarkably thick, it has not a tufted appearance; the old stem and the largest branches are covered with a thick, greenish, deeply-furrowed bark; the middle-aged branches are covered with a brown, white-spotted, slightly uneven bark; the twigs which terminate the branches are long, flexible, pendulous, smooth, and glossy; the leaf-stalks are short and covered with down; the leaves are greenish above, whitish beneath, remarkably angular, and about three inches long and two inches broad; and the fertile catkins are straight, nearly cylindrical, and five or six inches in length. The shoots of the tree, when about an inch in diameter, are used for the manufacture of hoops; its twigs are made into excellent street brooms; and its timber is compact, nearly white, and longitudinally streaked with mutually intersecting seed vessels, and is useful for various economical purposes. This species has a nobler appearance than most of the other birches, but has not yet obtained extensive favour with planters. It has frequently been called *Betula angulata*, and seems to be generally identified with *Betula rubra*, or the red birch. The latter, however, though closely resembling it, does not grow quite so high, and is a native of Canada.

The paper or canoe birch, *Betula papyracea*, is a native of various parts of North America, particularly Vermont, New Hampshire, New Brunswick, Maine, and Lower Canada, and was introduced to Great Britain about the middle of last century. It usually grows to the height of about 50 feet, yet frequently attains a height of 70 feet, with a stem-girth of 9 feet; and it always acquires its maximum of both height and bulk, either on the declivities of hills or in the bottoms of fertile valleys. Its branches are slender, flexible, and covered with a shining, brown, white-dotted bark; its leaves are middle-sized, ovate, occasionally heart-shaped, smooth, dark green, and serrated; and its catkins are pendulous and about an inch in length. This is the most valuable of all the birches, and comprises several varieties,—principally *Betula papyracea platyphylla*, distinguished by its very broad leaves,—and *B. p. trichoclada*, distinguished by the excessive hairiness of its branches. Its duramen or heartwood, when first laid open, is of a reddish colour; and its alburnum or sapwood is pure white. Its timber has considerable strength and a fine glossy grain; and the portions of it immediately below the first ramification of the stem, are cut into slices, which display undulations of fibre like bunches of feathers or sheaves of corn, and are used in the inlaying of mahogany. Its bark is so durable as to remain entire after the alburnum and the duramen have rotted away, and is used for the manufacture of hats, boxes, cases, and other articles, for the thatching of log-houses, and especially for the constructing of canoes. When a canoe is to be built, some trees of the largest size

and with the smoothest bark are selected, large sections of the bark are peeled off, nearly in the manner in which the bark of oaks is peeled in Great Britain, and these pieces are sewed together over a light wooden frame-work with the radical fibres of the white-spruce, and made water-tight along their lines of junction with a caulking of the resin of the Balm of Gilead fir. A canoe of this kind, capacious and buoyant enough to carry four persons and their baggage, weighs only from forty to fifty pounds.

The soft, pliant, sweet or cherry birch, or mountain mahogany, *Betula lenta*, is a native of Nova Scotia, Maine, Vermont, and the middle eastern states of America, and was introduced to Great Britain in 1759. It is the most interesting of the American birches, for both the beauty of its foliage and the value of its timber. It loves a deep, cool, loose soil, and usually grows to the height of about 50 feet, but frequently attains a height of 70 feet, with a stem-girth of from 6 to 9 feet. The bark of young trees is smooth, greyish, and exceedingly similar in appearance to that of the cherry-tree; and that of old trees spontaneously peels off in detached, hard, woody-looking plates, of six or eight inches in breadth. The leaves, for about a fortnight after their development, are covered with a thick silvery down, which they afterwards throw off; and they are serrated in the edge, heart-shaped at the base, pointed at the top, of fine tint and texture, not unlike those of the cherry, and emitting, when bruised in either their green or their dried condition, a very sweet odour, suitable for flavouring any culinary infusion. The barren catkins are flexible, and about four inches in length; and the fertile catkins are produced at the extremity of the young spray, and measure from 10 to 12 lines in length, and from five to six lines in diameter. The timber, when fresh cut, has a rosy tint, and afterwards deepens in colour by exposure; it has a fine, close grain, and is susceptible of a very high polish; and it is used for sofas, arm-chairs, the frames of coach panels, and various other purposes. This species is probably one of the most suitable for planting in British soils; but it has, as yet, obtained very little favour or notice. Michaux says respecting it, "I recommend it to the lovers of foreign vegetables, as eminently adapted, by the beauty of its foliage, and by the agreeable odour of its flowers, to figure in their parks and gardens." It is readily distinguished from most other species by the thinness and the oblong form of its leaves.

The hornbeam-leaved birch, *Betula carpinifolia*, though sometimes treated as a separate species, may be more properly considered as a variety of *Betula lenta*; it has indeed been often identified with that species; and it grows wild in the same countries, and usually attains the same height.—The Daurian birch, *Betula daurica*, is a native of Siberia, and was introduced to Great Britain in 1786. It usually grows to the height

of about 30 feet, and contributes its timber to some economical uses.—The tapering-leaved birch, *Betula acuminata*, grows wild on the mountains of Nepaul, but has not yet been introduced to Great Britain. It is a large tree, of noble appearance; it usually attains a height of from 50 to 60 feet, and is ramified almost from the surface of the ground; and its timber is employed for nearly every purpose which requires strength and durability in wood.—The Indian paper birch, *Betula bhojpattra*, grows wild on the mountains of Gurwal and Kumaon, but has not yet been introduced to Britain. It nearly resembles *Betula papyracea*, but is covered with bark of a pale cinnamon colour; and both it and *Betula acuminata* would be beautiful and probably useful accessions to the British sylva.—Two other species, obscure yet apparently interesting, occur in the same countries as *Betula bhojpattra*; and a curious but obscure species, a small evergreen plant, called *Betula antarctica*, grows in the region of Terra del Fuego.

The dwarf-birch, *Betula nana*, grows wild in the moist moors of Scotland, and in the mountainous regions of the northern part of the temperate zone, from Lapland eastward to Unalaschka in Asia. It is a curious, low, branching bush, usually of from two to four feet in height. Its leaves are round and serrated; its catkins are erect; and its winged fruit is said to be the favourite food of the ptarmigan. But the plant, though valuable to the Laplanders as fuel, is almost totally useless in Britain.—The long-leaved birch, *Betula nana macrophylla*, is a variety of the dwarf birch, growing wild in Switzerland, usually attaining a height of about 6 feet, and introduced to Great Britain in 1819.—The downy or pubescent birch, *Betula pubescens*, was introduced from Germany upwards of 30 years ago, and is an ornamental tree of usually about 30 feet in height. Its branches are erect, and covered with very close down; and its leaves are ovate, heart-shaped, serrated, and also covered with down. The nettle-leaved birch, *Betula urticifolia*, is another German species, but smaller than the preceding. The hairy dwarf birch, *Betula pumila*, is an ornamental species, of about 6 feet in height, introduced from North America in 1762. The shrubby or fruiting species, *Betula fruticosa*, is an ornamental shrub of 6 feet in height, introduced from Siberia about 28 years ago. The dark or sad birch, *Betula tristis*, is an ornamental small tree, of about 10 feet in height, growing wild in Kamstchatka, and recently introduced to Britain. The ovate birch, *Betula ovata*—formerly regarded as an alder, under the name of *Alnus viridis*—is an ornamental shrub, of about 6 feet in height, introduced from Hungary in 1820.

The several species of birch may be propagated from either seeds, layers, or cuttings. Seeds ought to be sown in beds of fine mould, and covered with soil to the depth of a quarter of an inch.

The young plants ought always to be kept quite free from weeds; and when they attain a height of about 3 or 4 feet, they are usually in good condition for being transplanted.—Vigorous young plants designed to yield shoots for layers ought to be transplanted for the purpose, a year before layering, to a spot of double-dug ground, and placed about 3 yards asunder; and if they make no proper shoots within the year, they must be headed down to within half a foot of the ground, and, next summer, they will make vigorous shoots. The shoots and twigs are layered in the usual manner; and one set of parent plants will produce new shoots, and may be used for layering, for a succession of years.—Cuttings, if set in a moist shady border about the beginning of October, may strike in considerable number; but they so frequently fail as to render propagation by the two other methods very decidedly preferable.—*Pallas' Flora Russica*.—*Michaux's Travels in America*.—*Gilpin's Forest Scenery*.—*Miller's Dictionary*.—*Marshall on Planting*.—*Sir John Sinclair's General Report of Scotland*.—*Useful and Ornamental Planting*.—*Papers of Messrs. Hawthorn and Baillie in the Gardener's Magazine*.—*Nicol's Planter's Kalendar*.—*Mill's Husbandry*.

BIRD-CATCHING. The art of taking birds or wild fowl. It is performed in various ways, according to the season of the year, or the species of bird intended to be caught.

If the flame of sulphur be held under the trees, on which birds are observed to perch during the night, they soon become suffocated, and fall down in a state of insensibility. In this manner pheasants are frequently caught.

If a portion of wheat, or any other grain, be steeped in a mixture of wine lees and hemlock juice, and then scattered in those places where birds are known to resort, they will speedily be inebriated by eating it, and drop down upon the ground, or become unable to escape.

When the ground is covered with snow, choose a spot within 20 or thirty yards of a window, door, or any other shelter, by which you may be concealed from the birds; and clear away the snow from a space about six or seven feet square. In the middle of this space place a wooden table or board; fasten to its sides several pieces of pipe staves, about six inches long and one broad, in such a manner that it may easily turn upon the nails; and under the four ends, which are not nailed, put four pieces of tile or slate, that they may not penetrate the ground, so as that the table may fall down upon the slightest jog. Make a small notch in the end of the table, in order to put into it the end staff, which should be seven inches long and one broad, and let the other end rest upon a piece of slate or tile. Arrange the whole in such a manner, that the board would be ready to fall towards the place where you stand, if it were not supported by the end staff; and to the middle of this staff let one

end of a small cord be fastened, while the other end is conveyed to your station. To make the board fall more readily, a little earth, or any other material least likely to frighten the birds, may be laid upon it; the whole is then to be covered with straw, and some grain scattered underneath and round about the board. When the birds perceive the ground free from snow and covered with straw, they will readily fly to pick up the corn round the board, and will gradually proceed to that which lies under it; the cord is then to be pulled, and the stick being thus drawn out, the board will fall down and secure the birds underneath.

The smaller kinds of birds are frequently taken with bird-lime, which is one of the most eligible modes in frost or snow, when all sorts of small birds assemble in flocks, and which may be used in various ways. Put the bird-lime into an earthen dish, with the addition of one ounce of fresh lard to every quarter of a pound, and melt the whole gently over the fire. Take a quantity of wheat ears, with a foot of the straw attached to each, and having warmed the lime that it may spread the thinner, lime about six inches of the straw from the bottom of the ears. Scatter a little chaff and threshed ears over a compass of 20 yards; stick the limed straws into the ground with the ears inclining downwards, or even touching the surface; traverse the adjoining places, in order to disturb the birds, and make them fly towards the snare; and by pecking at the ears of corn, they will become so entangled with the limed straws as to be easily taken with the hand. The lime may also be applied to cords, rods, and twigs, especially when it is intended to entangle the larger birds, such as snipes and field-fares; and for this purpose the following mode may be adopted. Take the main branch of any bushy tree with long straight and smooth twigs, such as the willow or birch; clear the twigs from every notch and prickly; lime the branches to within four fingers of the bottom, leaving the main bough, from which the others rise, untouched with the composition; and then place the bush where the birds resort.

Birds are taken also by various kinds of traps, which are frequently formed in a very simple manner, of nooses made of hair, and which are placed in different ways for different kinds of birds. The wheat-ears are so extremely timid, that they take shelter under a stone, or creep into holes whenever the sun is obscured by a cloud; and, by digging a number of small holes in the ground, in each of which is placed a noose of hair, they are taken in the open downs in great numbers. Woodcocks and snipes are caught in a similar manner, by placing the nooses along their paths, in marshy and moist grounds. Larks and other small birds may be taken in the same way, when the ground is covered with snow, by stretching along the surface 100 or 200 yards of packthread, pegging it

down at the distance of every 20 yards, and fastening, at every six inches, a noose of double horse hair. Some white oats are scattered along the line among the nooses, in order to entice the birds; and when three or four are taken, they must be removed from the noose, lest the others should be debarred from approaching.

One of the most successful modes of bird-catching is by the net, which is chiefly employed during the night, and which requires several other accompaniments. Take, for instance, two light and straight poles, ten or twelve feet long; tie two corners of the net to the smaller ends of these poles, and fasten the other two corners as far as they can be stretched towards the thicker part, connecting the sides of the net along the poles with a little packthread. Search for a bush or thicket to which the birds are likely to have retired; unfold the net, and pitch it exactly to the height of the bush, between the wind and the birds, as they always roost with their breasts towards the wind. Let a person, with a lantern or lighted torch, stand behind the middle of the net, while another beats the bushes on the opposite side, driving them towards the light, when they will readily fly to the quarter where the torch is held, and fall into the net. This method succeeds best in woods, where holly bushes grow under the trees, and when the weather is cold and dark. In open countries a trammel-net may be used, which is generally about thirty-six yards in length, and six in breadth, the lower end of which is plumbed to make it lie close, while the upper end is kept suspended at the two corners, and is thus dragged along the ground at about a yard in height. At each end lights must be carried, and persons stationed with long poles to raise up the birds as they proceed, and to take them as they ascend under the nets. Along with the nets and lights, a bell is frequently employed in open countries and stubble fields, from the middle of October to the end of March. At night, when the air is mild, take a low bell of a deep and hollow sound, and of such a size as to be conveniently carried in one hand; and provide a lantern or a square box, lined with tin, and open at one side, into which two or three large lights are to be placed. Fix the box to the breast, carry the bell in the left hand, and with the right hold a hand-net, about two feet broad and three long; or the light may be held in the hand, with the arm extended forward, while the bell is tied to the girdle, and hangs down upon the knees, by the motion of which it is made to sound. A companion may walk on each side, provided with a hand-net three or four feet square, but keeping a little behind, that he may not be within the reflection of the light. The sound of the bell makes the birds lie close, while the light also tends to overpower them; so that the net may easily be spread over them, as they are seen lying on the ground. Birds are also taken with nets during the day, especially in

those seasons of the year when they change their situation; in the month of October, for instance, when the wild birds begin to fly, and in March when the smaller kinds assemble for pairing. They are chiefly on the wing from day-break to noon, and always fly against the wind. The bird-catchers, therefore, lay their nets towards that point to which the wind blows. The nets employed in this way are generally twelve yards and a half long, and two and a half wide; and are spread on the ground parallel to each other in such a manner as to meet when turned over. They are provided with lines fastened in such a way, that, by a sudden pull, the bird-catcher is able to draw them over the birds that may have alighted in the space between those parallel sides. In order to entice the wild birds to alight among the nets, *call-birds* are employed, of which there must be one or two of each of the different kinds which are expected to be caught, such as linnets, goldfinches, greenfinches, woodlarks, red-poles, yellow hammers, titlarks, aberdavines, and bullfinches. Besides the *call-birds*, there are others denominated *flur-birds*, which are placed upon a moveable perch within the net, called a *flur*, and which can be raised or depressed at pleasure; and these are secured to the *flur* by means of a brace or bandage of slender silk string fastened round the body of the bird. The *call-birds* are disposed, at proper intervals, in cages, at a little distance from the nets; and as soon as they see or hear the approach of the wild birds, which they perceive long before it can be observed by the bird-catchers, they announce the intelligence, from cage to cage, with the greatest appearance of joy; and they proceed to invite them to alight, by a succession of notes, or short *jerks*, as they are termed by the bird-catchers, which may often be heard at a considerable distance. The moment that this call is heard by the wild birds, they stop their flight, and descend towards the nets; and so great is the ascendancy and fascination of the *call-birds*, that they can induce the others to return repeatedly to the nets, till every bird in the flock be caught.—Nightingales are taken with small trap-nets, without the aid of *call-birds*. These nets are not much larger than a cabbage-net; are surrounded at the bottom with an iron ring; and are baited with a meal-worm from the baker's shop.—In fine sunny weather, sky-larks are allured within reach of the clap-nets, by means of small bits of looking-glass fixed in a piece of wood in the middle of the nets, and put into a quick whirling motion, by a string in the hand of the bird-catcher. Grouse and partridge may be taken in the evening, by observing where they alight, and drawing a net over them; or, in the day-time, by employing a steady dog to point at them; and while their attention is fixed upon the animal, a large net, drawn by one person at each end, may easily be passed over them.

In the Orkney Isles, eggs and young birds are

collected by the inhabitants, in a most daring and hazardous manner. They climb up rocky precipices, more than 50 fathoms above the sea, where the shelves or ledges are scarcely broad enough for the birds to rest, or to form their nests; and, passing from one ledge to another, collect the eggs and birds, and descend again with the greatest ease and indifference. In most cases, however, they make the attempt from above; and are let down by a rope frequently made of straw or hogs' bristles, which are less apt than those made of hemp, to be cut by the sharpness of the rocks. A similar method is practised in the Feroe Islands, where the cliffs are in many places 200 fathoms high.

In Mexico and China aquatic birds are taken by the natives in the following very simple but ingenious manner. Empty gourds are left continually floating on the lakes, to which the birds resort, that they may be accustomed to approach them without alarm. The bird-catcher enters the lake with his body under water, and his head covered with a gourd; quietly advances to the ducks and geese that are swimming on the surface, and pulls them by the feet under the water, securing in this manner as many as he can carry away.

BIRD-CHERRY,—botanically *Cerasus Padus*. A native deciduous fruit-tree, of the cherry genus. It grows wild in the woods of Britain, and of other parts of Europe. It is erect and handsome, and attains a height, commonly of twenty feet, and frequently of thirty. The bark of the older shoots has a dark brown colour, inclining to purple, besprinkled with a few greyish spots; and the shoots of a preceding summer are smoother, and of a reddish hue. The buds for the future shoots begin to swell early in winter. The leaves are large, nearly oblong, serrated, rough, lighter in colour below than above, with two glandules at the base, and standing alternately on the branches. Spikes or long bunches of white flowers are produced from the sides of the branches, appear in April and May, and, by waving loosely and easily in every breeze of wind, have a very pleasing effect. The flowers which compose each spike stand on their own proper footstalks, and are arranged alternately along the spike stem. The fruit is first green, next red, and finally black, and ripens in August; and it is a small drupe or stone-hearted berry.

The beauty of the bird-cherry tree ought to obtain for it a frequent place in shrubberies and ornamental hedge-rows; and its great attraction for birds ought always to procure for it prominence in every situation where the presence of the small-feathered songsters is desired. Its timber is hard and close-grained, and is used for making whip and knife handles. Its leaves are eaten by swine, goats, sheep, and black cattle, but refused by horses; they emit, when bruised, a fragrance resembling that of rue; and they contain very decided traces of prussic acid. Its

fruit is nauseously and austere sweet, and, like the leaves, contains traces of prussic acid; but it is very greedily devoured by birds, and is often used for imparting a brandy-like flavour to British wines.—The red Cornish bird-cherry, *Cerasus padus rubra*, is sometimes regarded as a distinct species, yet is merely a variety of the common bird-cherry. It flowers two or three weeks earlier than the common sort, and has red instead of black fruit. Two varieties which have been introduced from the continent are the small-flowered and the long-bracted,—*C. p. parviflora* and *C. p. bracteosa*. The bird-cherry is called in Scotland hogberry.

BIRD-LIME. A glutinous matter of a very peculiar nature, employed for catching birds, mice, and other vermin; and prepared from different substances, in a great variety of ways. In former times, it was made chiefly from the berries of the mistletoe of oak, which were first boiled in water, then pounded, and the water poured off, in order to carry away the seeds and rhind. In England, it is generally made from the middle bark of holly, which is boiled in water, seven or eight hours, till it becomes soft and tender. After the water has been drained off, it is laid in masses in the earth, covered with stones, and left to ferment during a fortnight or three weeks. When thus changed into a kind of mucilage, it is taken from the pit; pounded in mortars till reduced to a paste; washed and kneaded in river water till freed from all extraneous matters. It is left in earthen vessels, four or five days, to purify itself by fermentation; and is then put up for use or commerce. In every kingdom, however, and almost in every district, there is a different mode of preparing this substance; and some profess to make a secret of their peculiar process. The mode employed by M. Bouillon Lagrange is, to take a sufficient quantity of the second bark of holly, to bruise it well, and boil it in water four or five hours; to pour off the water, to deposit the bark in pits in earthen pans, to moisten it from time to time with a little water; to let it remain till it become viscous, and to cleanse it by washing, when it has obtained a proper degree of fermentation. Bird-lime may be procured from the young shoots of the common elder tree, and from the second bark of the *viburnum*, or wild vine; from the roots of hyacinth, narcissus, asphodel, and black bryony; from slugs, snails, and the pods of certain caterpillars; but the best is that which is made from the prickly holly, and which is of a greenish colour. That which comes from Italy is made from the mistletoe; and that from Damascus is supposed to be procured from sebestins, as their kernels are frequently found amongst it. The bird-lime of commerce, in general, is seldom in a pure state, and is frequently a mixture of vegetable and animal substances. The common kind of bird-lime readily loses its tenacious quality, when long exposed to the air, and particularly

when subjected to moisture; but it may be rendered capable of sustaining the action of water, by the following process:—Take a pound of common bird-lime, and wash it thoroughly with spring water, till its hardness be destroyed. Then pound it completely, that its water may be entirely separated; and, when it is well dried, put it into an earthen pot, with as much goose or capon's grease as will make it run. Add two spoonfuls of strong vinegar, one of oil, and a small quantity of Venice turpentine; and let the whole boil for a few minutes over a moderate fire, stirring it all the time. It is then ready for use; and is the only kind that can be successfully used for snipes and other birds, which frequent wet situations.

When bird-lime is about to be applied to use, it should be made hot; and the rods or twigs should be warmed a little before they be dipped in it. When straws and cords are to be limed, it should be very hot; and, after they are prepared, they should be kept in a leather bag till used. In order to prevent bird-lime from being congealed by cold, it should be mixed with a little oil of petroleum; and, indeed, before the common kind can be used at all, it must be melted over the fire with a third part of nut oil, or any thin grease, if that has not been added in the preparation.

Bird-lime has generally been classed among the immediate productions of vegetables; and Fourcroy was the first person who considered it as of a glutinous nature. It has been carefully analyzed by M. Bouillon Lagrange, and has been found to resemble gluten in many particulars; but differs from it essentially in the acetous acid which it contains; in being very slightly animalized; in the mucilage and extractive matter which may be obtained from it; in the great quantity of resin which it yields by means of nitric acid; and in its solubility in ether.

BIRD-PEPPER,—botanically *Capsicum baccatum*. A tender evergreen, under-shrub, of the cayenne pepper genus. It is a native of the West Indies, and was introduced to the hothouses of Great Britain in 1731. Its stem is ligneous, and rises commonly to the height of 3 feet, and frequently to the height of four or five; its leaves are broad, lucid green, and rounder at the ends than those of other species of capsicum; its flowers are white, and grow at the division of the branches, and appear from June till September; and its fruit is small, oval, bright red, and much sharper and more biting than that of the other capsicums. Cayenne butter or American pepper pot is manufactured from this fruit, by drying it in the air, exsiccating it in an oven, and baking it up with flour; and, besides being capable of use in all the methods of common pepper, it is peculiarly esteemed for flavouring meat and sauces, assisting digestion, and acting as a carminative. See the article CAPSICUM.

BIRD'S EYE. A species of speedwell, of prim-

rose, and of adonis. The speedwell bird's eye is the wild germander,—*Veronica chamædrys*. It grows to the height of 6 inches, abounds in our groves, our meadows, our hedges, and especially our moist pastures, and is sometimes a troublesome weed in our arable fields. It is a perennial, and blooms in July and August. Its herbage is light green; and its flowers are numerous, short-lived, their centre white, their main part bright blue with dark streaks, their outside pale and flesh-coloured, and their whole appearance very beautiful, and almost vieing with the flowers of the forget-me-not,—*Myosotis palustris*.—The primrose bird's eye is the mealy species, *Primula farinosa*. It grows wild on the moist pastures of Great Britain, is an evergreen, attains a height of only three inches, and carries a beautiful dusty red flower in June and July. It shares with some varieties of auricula, the vulgar name of dusty-miller.—The adonis bird's eye is the autumnal species,—an annual species growing wild in the cornfields of some parts of Britain, producing a crimson flower from May till October, and better known under the popular name of pheasant's eye.

BIRD'S FOOT,—botanically *Ornithopus*. A genus of hardy, annual plants, of the leguminous family. The very small species, *Ornithopus perpusillus*, grows naturally on heaths, dry commons, and dry pastures in England. Its root consists of two or three strong fibres, and has attached to them several small knobs or tubercles like grains; many slender stems rise from the root, and spread along the ground to the length of from three to twelve inches; the leaves are small, hairy, and winged, each consisting of from five to twelve pairs of leaflets with a terminating odd one; the flowers are produced in tufts of three or four, on slender footstalks from the joints of the stem, are small and yellow or reddish-white, and appear from May till August; and the pods are short, incurved at the top, and shaped somewhat like the claws of birds. The whole plant has a curious and rather handsome appearance, yet it does not deserve a place in the flower-garden. The knotted variety of it, *O. p. nodosus*, grows abundantly in France, has a very creeping habit, and a whitish red flower, and is both larger and more ornamental than the normal plant. The intermediate variety, *O. p. intermedius*, is cultivated in Portugal as a valuable agricultural herbage plant, and is about the same size as the knotted variety; but it is now usually regarded as a distinct species, under the name of *Ornithopus sativus*.—The compressed species, *O. compressus*, is a native of the south of Europe, and was introduced to Britain upwards of a century ago. Four species formerly ranked as bird's foot, now constitute the genus *Astrolobium*, and are all annuals, with star-shaped pods.—Bird's foot is also the popular name of a very curious grotesque-looking evergreen, half-tender, under-shrub of the spurge genus,—*Euphorbia ornithopus*.

BIRD'S FOOT TREFOIL,—botanically *Lotus*. A large genus of plants, variously agricultural and ornamental, of the leguminous family. A considerable number of species formerly included in it are assigned by modern botanists to the genera *dorycnium*, *tetragonolobus*, *hosackia*, and *carmichaelia*; but about sixty species still belong to it, and nearly forty of these exist in a living state in Great Britain. Four of the species in Britain are indigenous; two are from Teneriffe, two from the Cape of Good Hope, one from North America, four from the Levant, one from the Cape Verd Islands, one from Barbary, one from the East Indies, and from Madeira; and most of the others are natives of the south of Europe. Six are evergreen, half-tender under-shrubs; one is a herbaceous, half-tender biennial; two are herbaceous, half-tender perennials; and most of the others are either hardy trailing perennials, or hardy trailing annuals. One has flowers either solitary or in pairs, and pods of a curved form; four have flowers somewhat umbellated, and pods of a long and compressed form; and most of the others have flowers in corymbs, and pods of a long and cylindrical form.

The small-horned species, *Lotus corniculatus*, grows wild on the open pastures of Great Britain, and possesses considerable recommendations as an agricultural herbage plant. It is a perennial, deciduous trailer, and ought not to be confounded by a farmer with the greater bird's foot trefoil, *Lotus major*. Its root is branching and somewhat ligneous, and has its fibres marked with small granulations; several stems rise from each root, are either simple or branched, spread in every direction along the ground, and have a length of from three to about twenty inches; the floral footstalks are either erect or recumbent, and five times as long as the leaves; from two to five flowers grow on each footstalk, appear from June till August, and are bright yellow when fresh, orange when decaying, and dark green when dried. Linnæus says that sheep and swine do not relish this plant, and that goats, cows, and horses eat it. Dr. Anderson, mistaking it for an astragalus, recommends it as excellent for both green fodder and hay. Mr. Curtis and Mr. Wood speak favourably of it as an agricultural plant. Professor Martyn says that, in common with several other leguminous plants, it renders hay firm and substantial, and probably increases both its wholesomeness and its agreeable flavour. Mr. Woodward says that, in moist meadows, it grows to a greater height than the clovers, is equal, if not even superior, to most of them in quality, and makes extremely good hay. Mr. Sinclair gives it a qualified recommendation, and shows it to possess both good and bad properties, and to be suitable for some situations and unsuitable for others. Sheep, contrary to Linnæus' opinion, readily eat it along with the herbage among which it grows. Its flowers, indeed, appear to be much disrelished, and are always left untouched; and,

on dry pastures, on account of the plant's diminutive size and creeping habit, the flowers are unhappily the chief part of it which cattle can reach. But sheep treat white or Dutch clover very nearly in the same manner as this plant, seldom touching the flowers as long as they can obtain any of the foliage. Small horned bird's foot trefoil contains a larger proportion of bitter extractive and saline elements than the clovers: and the latter plants contain a greater proportion of these principles than the grasses; and small horned bird's foot trefoil might, therefore, be an advantageous admixture where clovers are scarce, but is too bitter and saline to be anywhere, with propriety, a large ingredient in pastures. It is fond of dry soils; it soars to unusual height, and nearly loses its procumbent habit, when growing among shrubs; and it ought either to exist in very small proportion, or to be altogether wanting, in irrigated meadows or in any moist pasture grounds which produce a succulent herbage. It makes no contribution to the exigencies of pasturage in spring, but continues to vegetate to a late period in autumn. An acre of it, according to the Woburn experiments, yields 10,209 lbs. of green produce, 3,190 lbs. of dry produce, and 358 lbs. of nutritive matter.—A double-flowered variety of this species, *Lotus corniculatus flore plene*, is grown as an ornamental plant in our gardens; and three varieties, the alpine, the thick-leaved, and the villous, *alpinus*, *crassifolius*, and *villosus*, are natives of Continental Europe, the first and the third particularly of Switzerland, and have been introduced to Britain as ornamental plants. But the stems of all these varieties, on the average, attain only about one-third the length of those of the normal plant.

The greater bird's foot trefoil, *Lotus major*, grows wild in wet shady grounds in Great Britain; and is also a perennial, deciduous trailer, and an agricultural plant of considerable value. In fact, it possesses fully double the value of the preceding species; and yet, by careless observers, or even by practical farmers, has often been confounded with it. Its fondness for wet situations is quite as decided as that of the small horned bird's foot trefoil is for very dry soils; its stems are from one foot to three feet in length, covered with long and loosely-spreading hairs, and not so procumbent as those of *Lotus corniculatus*; its leaves are fringed with hairs similar to those upon the stems; and its flowers are of a duller hue than those of *Lotus corniculatus*, grow in groups of from six to twelve in each head, and bloom from about the third week of June till August. On clayey soils, on all kinds of moist soils, and on the richest kind of dry soils, it yields a larger produce than perennial red clover; but the nutritive matter of this produce is about one-fifth less than that of the clover, and contains a very sensible and unpleasant degree of bitter extractive. The plant in its green state is disliked by all classes of live stock; but when made

into hay, it is readily eaten by deer, sheep, and black cattle. It matures a smaller quantity of seed than the small horned species, but amply compensates this defect by propagating itself in the manner of the strawberry and of stoloniferous grasses. It might be a very profitable substitute for red clover on all wet and stiff soils; but, on account of its large proportion of bitter and saline principles, it requires a comparatively large accompaniment of other herbage. An acre of it, according to the Woburn experiments, yields 21,780 lbs. of green produce, 8,142½ lbs. of dry produce, and 680½ lbs. of nutritive matter.

The narrowest bird's foot trefoil, *Lotus angustissimus*, grows wild on sea-beaches and on meadows near the sea, in Great Britain. It is a trailing annual; its stems are usually about a foot in height; and its flowers are yellow, and appear from May till August.—The diffuse bird's foot trefoil, *Lotus diffusus*, grows on rocks in England. It is a trailing annual; its stems are usually about 18 inches in length, and its flowers are yellow, and appear in May and June.—The decumbent bird's foot trefoil, *Lotus decumbens*, was introduced to Britain from Continental Europe in 1816. It is a trailing annual; its stems are usually about 6 inches in length; and its flowers appear in July and August.—Forster's species, *Lotus forsteri*, called by Forster himself and some other botanists *Lotus decumbens*, grows wild in fields and meadows, but principally on heathy grounds in England. It is a trailing perennial; its stems are usually about 6 inches in length; its floral footstalks are smooth, firm, strong, and about five times the length of the leaves; and its flowers are collected into umbels of five or six, have a bright yellow colour, and appear in July and August.—All the species already noticed have long cylindrical pods; but the esculent species, *Lotus edulis*, has curved pods, and is cultivated in some countries for the sake of these. It was introduced to Great Britain from Italy in 1710; it is a hardy trailing annual, with stems of about 6 inches in length; and its flowers are yellow and frequently solitary, and appear in July and August.

The St. James' Island bird's foot trefoil, *Lotus Jacobæus*, was introduced to Britain from the Cape Verd Islands in 1714; and is cultivated by our gardeners as an ornamental greenhouse plant. Its stem is slender, very ligneous, and about two or three feet high; its branches are slender, herbaceous, and very numerous; its leaves are narrow, grey, slightly hoary, almost sessile, and sometimes trifoliate, sometimes quinquelfoliate; its flowers are produced on very slender footstalks from the sides of the stems, are collected into heads of four or five, have a yellowish deep purple colour, and may be made to bloom throughout the whole year; and its pods are slender, tapering, and little more than an inch in length, each containing five or six small roundish seeds. A variety of it, called *Lotus Jacobæus luteus*, is dis-

tinguished chiefly by the lighter colour or yellowness of its flowers.—The Cretan bird's foot trefoil *Lotus Creticus*, is also cultivated in Britain as an ornamental greenhouse plant; and it was introduced about 160 years ago from the Levant. Its stems rise to the height of three or four feet, but are slender and require support; its branches are few and lateral; its leaves are neat, shining, silvery, and trifoliate, and grow from the joints of the branches; its floral footstalks rise from the side of the branches, and have a length of two or three inches; and its flowers grow in heads of four or six, have a yellow colour, and appear from June till September.—These two species, as well as two other ornamental greenhouse kinds, are propagated by cuttings.—A hardy perennial herbaceous ornamental species, called *Lotus palustris*, was introduced a few years ago from Crete, and must not be confounded with the Cretan species.—The only other sort we can afford to notice is *Lotus odoratus*, distinguished for its fine fragrance, introduced about forty years ago from Barbary, and having the characters of an erect, deciduous, perennial-rooted herb.

BIRD'S NEST,—botanically *Monotropa*. A genus of curious plants, of the heath tribe. They are not true heaths, nor do they belong to the rhodora and rhododendron family, but constitute of themselves a subsection of ericæ. The under-pines species, *Monotropa hypopitys*, grows indigenously in Britain, and is met with occasionally on poor and gravelly open grounds, but most frequently in woods, under firs and beeches. It particularly abounds in the midland counties of England. Its root is fibrous, branched, and rather creeping; its stem is solitary, and about half a foot in height; and its flowers grow in a drooping cluster, are white in colour, and appear in June and July.—A species somewhat like the British one, and called *Monotropa uniflora*, was introduced a few years ago from North America. Several other species are known.—Bird's nest is also the popular name of a very beautiful hot-house fern, of the spleenwort genus, introduced about twenty years ago from the East Indies,—*Asplenium nidus*.—Bird's nest was likewise, till quite recently, the popular name of the wild carrot, *Daucus carota*.

BIRTHWORT. See **ARISTOLOCHIA**.

BISCUIT. A hard, dry, flat bread cake. It acquired its name from the old and obsolete process of twice-baking. It is free from yeast, and therefore better suited to the stomach of infants and dyspeptic persons than fermented bread; and it is deprived of moisture by the particular method of baking, and therefore keeps very much longer than loaf bread. The unleavened bread of the Jews, and the loaf or cake mentioned in several passages of the New Testament Scriptures, were biscuits. The modern use of the biscuit is very common on land, by both the luxurious and the dyspeptic; and it is perfectly indispensable during all sea-voyages which are longer in con-

tinuance than the usual duration of freshness in loaves. Sea-biscuits are baked in all large seaports for the supply of merchant-vessels, and in certain great manufactories for the supply of the national navy; and they are of two qualities, a finer and a coarser,—the latter more nutritive than the former, and made of ground wheat from which nothing but the bran has been separated. Coarse sea-biscuits are one of the most nourishing, digestible, and grateful forms of prepared human food.—The numerous pastry articles sold under the name of biscuits by confectioners, are exceedingly various in composition, and possess scarcely one property in common with true biscuits. The word biscuit has also a technical use in the manufacture of earthenware.

BISCUTELLA. See **BUCKLER MUSTARD**.

BISHOPING. See **AGE OF ANIMALS**.

BISHOP'S WEED. Two annual umbelliferous plants, of the genera *ammi* and *sison*. The greater bishop's weed, *Ammi majus*, is a native of the south of Europe, was brought to Britain about the middle of the 16th century, and now grows wild in some districts by the side of hedges. Its stem is firm, round, striated, and about two feet high; its flowers are white, form large umbels at the top of the stem, appear in June and July, and give the plant some resemblance to parsley when in bloom; and its seeds are ripened in August, have a warm and aromatic taste, and were formerly used in medicine. When the plant is cultivated, it is treated as a biennial, or sown in autumn where it is to remain.—The other bishop's weed was formerly called *Pimpinella lateriflora*, but is now called *Sison ammi*. It was introduced to Britain from the south of Europe in 1819, grows about a foot high, and produces white flowers in July and August.

BISMUTH. A simple metal, of specific gravity 9.822, or nearly ten times heavier than water. It is nearly as fusible as tin, and rather softer than copper; and, when slowly cooled, crystallizes in cubes. It has a reddish white colour, and appears as if formed of mutually adhering broad shining plates. It is neither very brittle nor very malleable, but breaks by a stroke, and can be reduced to powder. Its ores are usually metallic, not very widely diffused, most plentiful in Saxony, less plentiful in Cornwall, France, and Sweden; and they generally contain cobalt. Bismuth itself produces no effect on the animal system; but the subnitrate of it has recently been introduced to human medicine, and will probably be introduced to farriery, as a valuable and very powerful drug. This drug is very easily prepared by the action of nitric acid upon the metal, and is a perfectly white, tasteless, and odourless powder. A dose of it varies from one grain to about twelve grains; but is far too active and critical to be prescribed by any person but a regular and skilful practitioner. It acts advantageously in spasmodic affections, palpitations of the heart, and epilepsy,

and is regarded as quite a specific in all varieties of dyspepsia, or feebleness of stomach, in which the organ itself is sound and merely weak. But an overdose acts with tremendous virulence, produces the most violent symptoms, and may even occasion death.

BISON. From other species of the ox kind, the bison is well distinguished by the following peculiarities. A long shaggy hair clothes the fore part of the body, forming a well marked beard beneath the lower jaw, and descending behind the knee in a tuft. This hair rises on the top of the head in a dense mass, nearly as high as the extremities of the horns. Over the forehead it is closely curled, and matted so thickly as to deaden the force of a rifle ball, which either rebounds, or lodges in the hair, merely causing the animal to shake his head as he heavily bounds along. The head of the bison is large and ponderous, compared to the size of the body; so that the muscles for its support, necessarily of great size, give great thickness to the neck, and by their origin from the prolonged dorsal vertebral processes form the peculiar projection called the *hump*. This hump is of an oblong form, diminishing in height as it recedes, so as to give considerable obliquity to the line of the back. The eye of the bison is small, black, and brilliant; the horns are black and very thick near the head, whence they curve upwards and outwards, rapidly tapering towards their points. The outline of the face is somewhat convexly curved, and the upper lip, on each side being papilous within, dilates and extends downwards, giving a very oblique appearance to the lateral gap of the mouth, in this particular resembling the ancient architectural bas-reliefs representing the heads of oxen. The physiognomy of the bison is menacing and ferocious, and no one can see this formidable animal in his native wilds, for the first time, without feeling inclined to attend immediately to his personal safety. The summer coat of the bison differs from his winter dress, rather by difference of length than by other particulars. In summer, from the shoulders backwards, the hinder parts of the animal are all covered with a very short fine hair, that is as smooth and as soft to the touch as velvet. The tail is quite short and tufted at the end, and its utility as a fly-brush is necessarily very limited. The colour of the hair is uniformly dun, but the long hair on the anterior parts of the body is to a certain extent tinged with yellowish or rust colour. These animals, however, present little variety in regard to colour.—In *Plate VIII.* we have given figures of the bison from the work of the eminent American naturalist, to whose pages we are also indebted for the present article.

Some varieties of colour have been observed, although the instances are rare. A Missouri trader informed the members of Long's exploring party, that he had seen a greyish white bison, and a yearling calf, that was distinguished by

several white spots on the side, a star or blaze in the forehead, and white fore feet. Mr. J. Doughty, an interpreter to the expedition, saw in an Indian hut a very well prepared bison head, with a star on the front. This was highly prized by the proprietor, who called it his Great Medicine, for, said he, "the herds come every season to the vicinity to seek their white-faced companion."

In appearance, the bison cow bears the same relation to the bull that is borne by the domestic cow to her mate. Her size is much smaller, and she has much less hair on the fore part of her body. The horns of the cow are much less than those of the bull, nor are they so much concealed by the hair. The cow is by no means destitute of beard, but though she possesses this conspicuous appendage, it is quite short when compared with that of her companion. From July to the latter part of December, the bison cow continues fat. Their breeding season begins towards the latter part of July, and continues until the beginning of September, and after this month, the cows separate from the bulls in distinct herds, and bring forth their calves in April. The calves rarely separate from the mother before they are one year old, and cows are frequently seen accompanied by calves of three seasons.

The flesh of the bison is somewhat coarser in its fibre than that of the domestic ox, yet travellers are unanimous in considering it equally savoury as an article of food; we must, however, receive the opinions of travellers on this subject with some allowance for their peculiar situations, being frequently at a distance from all other food, and having their relish improved by the best of all possible recommendations in favour of the present viands—hunger. It is with reason, however, that the flesh is stated to be more agreeably sapid, as the grass upon which these animals feed is short, firm, and nutritious, being very different from the luxuriant and less saline grass produced on a more fertile soil. The fat of the bison is said to be far sweeter and richer, and generally preferable to that of the common ox. The observations made in relation to the bison's flesh, when compared with the flesh of the domestic ox, may be extended to almost all wild meat, which has a peculiar flavour and raciness that renders it decidedly more agreeable than that of tame animals, although the texture of the flesh may be much coarser and the fibre by no means as delicate.

Of all the parts of the bison that are eaten, the hump is the most famed for its peculiar richness and delicacy; because, when cooked, it is said very much to resemble marrow. The Indian mode of cooking the hump is to cut it out from the vertebrae, after which the spines of bone are taken out, the denuded portion is then covered with skin, which is finally sewed to the skin covering the hump. The hair is then singed and pulled off, and the whole mass is put in a hole dug in the earth

for its reception, which has been previously heated by a strong fire in and over it the evening previous to the day on which it is to be eaten. It is then covered with cinders and earth about a foot deep, and a strong fire made over it. By the next day at noon, it is fit for use. The tongues and marrow bones are also highly esteemed by the hunters. To preserve the flesh for future use, the hunters and Indians cut it into thin slices and dry it in the open air, which is called *jerking*; this process is speedily finished, and a large stock of meat may thus be kept for a considerable length of time. From the dried flesh of the bison the fur-traders of the American north-west prepare a food which is very valuable on account of the time it may be preserved without spoiling, though it will not appear very alluring to those who reside where provisions are obtained without difficulty. The dried bison's flesh is placed on skins and pounded with stones until sufficiently pulverized. It is then separated as much as possible from impurities, and one-third of its weight of melted tallow of the animal is poured over it. This substance is called *pemmican*, and being packed firmly in bags of skin of a convenient size for transportation, may be kept for one year without much difficulty, and with great care, perhaps two years. During the months of August and September the flesh of the bison bull is poor and disagreeably flavoured; they are, however, much more easily killed, as they are not so vigilant as the cows, and sometimes allow the hunter to come up with them without much difficulty. Lewis and Clarke relate that once approaching a large herd, the bulls would scarcely move out of their way, and as they came near, the animals would merely look at them for a moment, as at something new, and then quietly resume their grazing.

The general appearance of the bison is by no means attractive or prepossessing, his huge and shapeless form being altogether devoid of grace and beauty. His gait is awkward and cumbrous, although his great strength enables him to run with very considerable speed over plains in summer, or in winter to plunge expeditiously through the snow. The sense of smelling is remarkably acute in this animal, and it is remarked by hunters that the odour of the white man is far more terrifying to them than that of the Indian. From the neighbourhood of white settlements they speedily disappear: this, however, is very justly accounted for by Mr. Say, who attributes it to the impolitic and exterminating warfare which the white man wages against all unsubdued animals within his reach. To the Indians and visitors of the western regions the bison is almost invaluable; we have mentioned that they supply a large part of the food used by the natives, and covering to their tents and persons, while in many parts of the country there is no fuel to be obtained but the dried dung of this animal. The Indians always associate ideas of

enjoyment with plenty of bison, and they frequently constitute the skull of one of them their 'Great Medicine.' They have dances and ceremonies that are observed previous to the commencement of their hunting.

The herds of bison wander over the country in search of food, usually led by a bull most remarkable for strength and fierceness. While feeding, they are often scattered over a great extent of country, but when they move in mass they form a dense, almost impenetrable column, which, once in motion is scarcely to be impeded. Their line of march is seldom interrupted even by considerable rivers, across which they swim without fear or hesitation, nearly in the order that they traverse the plains. When flying before their pursuers, it would be in vain for the foremost to halt or attempt to obstruct the progress of the main body, as the throng in the rear still rushing onward, the leaders must advance, although destruction awaits the movement. The Indians take advantage of this circumstance to destroy great quantities of this favourite game, and, certainly, no mode could be resorted to more effectually destructive, nor could a more terrible devastation be produced, than that of forcing a numerous herd of these large animals to leap together from the brink of a dreadful precipice, upon a rocky and broken surface, a hundred feet below. When the Indians determine to destroy bison in this way, one of their swiftest footed and most active young men is selected, who is disguised in a bison skin, having the head, ears, and horns adjusted on his own head, so as to make the deception very complete, and thus accoutred, he stations himself between the bison herd and some of the precipices, that often extend for several miles along the rivers. The Indians surround the herd as nearly as possible, when, at a given signal, they show themselves and rush forward with loud yells. The animals being alarmed, and seeing no way open but in the direction of the disguised Indian, run towards him, and he, taking to flight, dashes on to the precipice, where he suddenly secures himself in some previously ascertained crevice. The foremost of the herd arrives at the brink—there is no possibility of retreat, no chance of escape: the foremost may for an instant shrink with terror, but the crowd behind, who are terrified by the approaching hunters, rush forward with increasing impetuosity, and the aggregated force hurls them successively into the gulf, where certain death awaits them. It is extremely fortunate that this sanguinary and wasteful method of killing bisons is not very frequently resorted to by the savages, or we might expect these animals in a few years to become almost entirely extinct. The waste is not the only unpleasant circumstance consequent on it; the air for a long time after is filled with the horrible stench arising from the putrefying carcasses not consumed by the Indians after such an extensive and indiscriminate

slaughter. For a very considerable time after such an event, the wolves and vultures feast sumptuously and fatten to tameness on the disgusting remains, becoming so gentle and fearless as to allow themselves to be approached by the human species, and even to be knocked down with a stick, near places where such sacrifices of bison have been made. Lewis and Clarke bestowed the name of Slaughter River on one of the tributaries of the Mississippi, in consequence of the precipices along its sides having been used by the Indians for this mode of killing the bison.

A better and more common way of killing bison is that of attacking them on horseback. The Indians, mounted and well armed with bows and arrows, encircle the herd and gradually drive them into a situation favourable to the employment of the horse. They then ride in and single out one, generally a female, and following her as closely as possible, wound her with arrows until the mortal blow is given, when they go in pursuit of others until their quivers are exhausted. Should a wounded bison attack the hunter, he escapes by the agility of his horse, which is usually well trained for the purpose.—In some parts of the country, the hunter is exposed to a considerable danger of falling, in consequence of the numerous holes made in the plains by the badger.

The skins of the bison furnish the Indians and Whites with excellent robes, for bedding, clothing, and various purposes. These are most usually the skin of cows, as the hide of the bull is too thick and heavy to be prepared in the way practised by the squaws, which is both difficult and tedious. This consists in working the hide, moistened with the brains of the animal, between the hands, until it is made perfectly supple, or till the thick texture of the skin is reduced to a porous and cellular substance. These robes form an excellent protection from rain, when the woolly side is opposed to it, and against the cold when the woolly surface is worn next the skin. But when these robes are wet, or for a considerable time exposed to moisture, they are apt to spoil and become unpleasant, as the Indian mode of dressing has no other effect than to give a softness and a pliancy to the weather. On these robes the Indians frequently make drawings of their great battles and victories; a great variety of such painted robes are to be seen in the Philadelphia Museum. The hair of the bison has been used in the manufacture of a coarse cloth, but this fabric has never been extensively employed.

We have already adverted to the great numbers of these animals which live together. They have been seen in herds of three, four, and five thousand, blackening the plains as far as the eye could view. Some travellers are of opinion that they have seen as many as eight or ten thousand in the same herd, but this is merely a conjecture. At night it is impossible for persons to sleep near

them who are unaccustomed to their noise, which from the incessant lowing and roaring of the bulls, is said very much to resemble distant thunder. Although frequent battles take place between the bulls, as among domestic cattle, the habits of the bison are peaceful and inoffensive, seldom or never offering to attack man or other animals, unless outraged in the first instance. They sometimes, when wounded, turn on the aggressor, but it is only in the rutting season that any danger is to be apprehended from the ferocity and strength of the bison bull. At all other times, whether wounded or not, their efforts are exclusively directed towards effecting their escape from their pursuers, and at this time it does not appear that their rage is provoked particularly by an attack on themselves, but their unusual intrepidity is indiscriminately directed against all suspicious objects.—*Godman's Natural History.*

BISTORT, or SNAKEWEED,—botanically *Polygonum Bistorta*. A perennial, herbaceous, medicinal plant, of the polygonum genus. It grows in moist shady places, and in meadows and pastures of Great Britain; and occurs in Siberia, Japan, and many parts of continental Europe, generally in similar situations as in Britain, but occasionally on alpine ground, at the elevation of even about 4,500 feet above sea-level. Its root is ligneous, contorted, thick, and creeping; its stem is solid, smooth, leafy, jointed, swelling at the joints, somewhat nodding at the top, and usually from 18 to 24 inches high; its leaves are entire, waved in the edge, a fine green above, smooth below, the lower ones heart-shaped, lanceolate, and standing on long winged footstalks, and the upper ones ovate and almost sessile; and its flowers are small, of a pale rose colour, and collected into a close oblong spike of one inch and a half in length, and appear from May till September.

The dried root has a very austere taste, but no smell; contains a large proportion of tannin, some gallic acid, and much starch, and gives up its medicinal principles in the form of extract in water. It is employed externally, in human pharmacy, in the form of lotion, for spongy gums and bad ulcers; and internally, in various forms, for dyspepsia, hemorrhage, prolonged dysentery, and, in general, as a tonic and an astringent. White says respecting the use of bistort in farriery, "The roots of this plant are considered the most powerful of the vegetable astringents; they have been recommended as a styptic to restrain hemorrhages; but ought never to be depended on for this purpose. Many imaginary virtues have been attributed to this plant; perhaps as a powerful astringent, it may be useful in certain cases of diarrhoea, particularly that to which horned cattle are subject. The dose is from half an ounce to an ounce, and may be given either in powder, or boiled in water and made into a drench.



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The alpine bistort, *Polygonum viviparum*, is also a herbaceous perennial, but differs in both habit and chemical principle from the snakeweed bistort. It grows on lofty pastoral mountains in Great Britain, either among the moist sward or in moist fissures of rocks. Its root is somewhat astringent, but not medicinal; its stem seldom exceeds 6 inches in height; and its flowers are stalked and whitish green, and appear from May till September.

BIT. The iron part of a bridle, put into a horse's mouth, and of chief use for restraining and controlling him. Many a bit is too sharp, and sometimes ulcerates the base of the mouth, and wears part of the lower jaw down to the bone, or tears portions of it away. Little sores in the mouth, usually ascribed to rustiness of the bit, are far oftener occasioned by contusions either from a sharp bit, or from a too severe use of a moderate one. Extreme play of the bit is sheer wanton cruelty to a docile animal, and may sometimes provoke an obstinate one so to rear as to endanger both himself and his rider.

BITE. A wound inflicted on one animal with the teeth of another. An ordinary bite must be treated as a lacerated wound; and a venomous bite, whether inflicted by a reptile or by a hydrophobous quadruped, must be treated first for the extraction of the poison, and next for the healing of the incision. See the articles WOUNDS and POISON.

BITHWORT. See *ARISTOLOCHIA*.

BITTER OAK. See *OAK*.

BITTER PRINCIPLE. The extractive portion of many plants is often termed *bitter extract*, or *bitter extractive*, from its possessing a bitter taste; and it was formerly divided into mild, acrid, and narcotic.

The bitter portions of plants, if fresh, are pressed, or if dry, are extracted with water, and the juice or solution concentrated by evaporation, when a deposit usually takes place, consisting of albumen, apothem, and insoluble salts of lime, &c. The filtered liquor is evaporated to an extract, and treated with dilute alcohol, which extracts the bitter principle in a purer state, leaving starch, gum, salts, &c.

Prepare an extract of the plant directly with dilute alcohol and treat it with water, which dissolves the bitter, leaving resin. In either case the solution yields, by evaporation, a dark-coloured extract, which, besides the bitter, contains resin, sugar, colouring matter, and various salts. Absolute alcohol removes resin and some salts; some of the salts may also be removed by adding sulphuric acid to the tincture, and forming sulphates insoluble in alcohol, while the excess of sulphuric acid is removed by carbonate of lead. Sugar is removed by fermentation. The colouring matters are removed by neutral acetate of lead. To the filtered solution add basic acetate of lead, wash the precipitate with a little cold water, suspend it in water, decompose it by sul-

phuretted hydrogen, filter, and evaporate. The bitter principle thus obtained is probably not always free from a little foreign admixture.

The bitter principle is uncrystallizable, yellowish or brownish, translucent, and, after perfect drying, brittle, with conchoidal fracture, and pulverizable. It is heavier than water, inodorous, with a pure bitter taste, soluble in water and spirit of wine, but not in absolute alcohol, ether, or the oils. Subjected to dry distillation it yields gases, an acid, generally an ammoniacal liquid, empyreumatic oil, and charcoal. It burns with a feeble flame in the air, leaving a porous charcoal, which generally yields ashes by combustion.

By repeated evaporation, or by the action of chlorine, it deposits apothem. Its solution is rendered darker by alkali without precipitation. Alumina, most metallic oxides, and especially basic acetate of lead, form insoluble or difficultly soluble precipitates. It does not precipitate with gelatin. Many bitters are abstracted from a solution by boiling with bone-black, with which they enter into combination. The above properties are general, and subject to exceptions from the presence of other substances.

The exact chemical character of the different kinds of bitter has not been determined, nor is it at all probable that they will agree in their constitution, or other essential characteristics. The following list comprises some of those best determined, which are free from nitrogen, and have a neutral reaction:—

Absinthin, flowers of *Artemisia absinthium*.

Aloin, *Aloë spicata*.

Bryonin, root of *Bryonia alba*.

Cathartin, leaves of *Cassia lanceolata*.

Cetrarin, *Cetraria Islandica*.

Colocyntin, seed-pulp of *Cucumis Colocynthis*.

Columbin, root of *Menispermum palmatum*.

Cusparin, bark of *Galipea cusparia*.

Daphnin, *Daphne Mezereum*, &c.

Elaterin, fruit of *Momordica elaterium*.

Ergotin, Ergot of Rye.

Frazinin, bark of *Fraxinus excelsior*.

Gentianin, root of *Gentiana lutea*.

Hesperidin, spongy part of Orange-rind.

Ilicin, leaves of *Ilex aquifolium*.

Lactucin, *Lactuca sativa*, &c.

Liriodendrin, root-bark of *Liriodendron tulipifera*.

Lupulin, female flowers of *Humulus Lupulus*.

Olivil, Gum-resin of *Olea Europea*.

Olin, leaves of do. do.

Picrolichenin, *Variolaria amara*.

Picrotoxin, *Menespermum cocculeus*.

Phyllyrin, bark of *Phillyrea media*.

Quassiin, wood of *Quassia amara*.

Scillitin, bulb of *Scilla maritima*.

Tanacetin, *Tanacetum vulgare*.

Tanghinin, seeds of *Tanghinia Madagascariensis*.

Xanthopicrin, bark of *Xanthoxylon Clava Herculis*.

Bitters are so generally known to act as tonics, strengthening the stomach, improving the appetite, and assisting digestion, that they are popularly termed stomachics. A deficient supply of bitter matter, either in any one plant or in accompanying articles of food, prevents saccharine matter from having a nourishing and fattening

effect, occasions gummy matter to glide from the stomach and pass through the intestines without yielding more than a mere fraction of its nutritiousness, and causes food of a watery kind, such as cattle obtain in moist meadows and wet pastures, to produce rot and several other diseases. The highly nourishing powers of both gum and sugar upon man and the lower animals, and the highly fattening power of succulent herbage upon cattle, are thus altogether dependent on the digestive aid of bitters. But if used as more than a mere condiment to the healthy stomach, or as a tonic for the restoration of impaired powers of digestion, bitters enrich the secretion, increase the blood, create a plethoric habit, and originate inflammatory action and other forms of disease. Bitters act most beneficially, in cold and damp districts, for preventing ague and intermittent fever, or, in a warm and debilitating climate, for preventing languor. The frequency of disease and prevalence of leanness among the live stock of a farm, may often be very distinctly traceable to the want of a sufficient intermixture of bitterish plants in the herbage; and the tendency to aguish disorders among the inhabitants of fenny districts might often be in a great degree counteracted, by the general and judicious use of bitters in spring and autumn.

BITTERSWEET,—botanically *Solanum Dulcamara*. A perennial deciduous climbing plant, of the nightshade genus. It is sometimes called perennial climbing nightshade. It grows wild in hedges and thickets, near rivers and ditches, and in other damp and shady situations in Great Britain. Its stem is woody, of a bluish colour, about three feet in length, but capable of being trained to ten feet, and emitting, when bruised or broken, a disagreeable odour similar to that of rotten eggs; its flowers have a beautiful violet or purple colour, with yellow streaks in their middle, and appear in June and July; and its berries are oblong-oval, red, juicy, bitter, and poisonous, and become ripe in August. Two varieties with respectively white and variegated flowers also grow wild in Britain, and have a taller habit than the normal plant. Bittersweet is sometimes planted in gardens in the vicinity of London, to cover arbours or shady walls, in situations where few other climbing plants will grow; and cuttings or small stems of it are sometimes placed in glasses of water in rooms, and they there continue for a long time green and growing, and putting out leaves and branches. A decoction of the sliced stem and young shoots has long been known as a medicine, but is far too active to be used by a quack or a mere domestic practitioner.

BITTER VETCH,—botanically *Orobus*. A genus of herbaceous ornamental plants, of the pea tribe. About fifty species are known to botanists; and between thirty and forty of these exist in a living state in Great Britain. One of the latter, the rock species, is a hardy annual, and all the others are hardy perennials;—four,

the loose-flowered, the beautiful, the hairy, and the lathyrus-like, have one-paired leaves, with ovate or linear leaflets, and most of the others have many-paired leaves, with in some instances broad leaflets, and in others very narrow leaflets;—three, the tuberous, the sylvan, and the black, are indigenous in Britain, and most of the others are natives of continental Europe. Nearly all the native and introduced species deserve a place in the flower garden, on account of their elegant papilionaceous flowers, and will grow on any soil, and can easily be propagated either from seeds or by dividing the roots; but in no instance are they equal to any of our present field legumes or agricultural plants. We can afford a fuller notice of only two of the indigenous and one of the exotic species as exemplifications of the genus.

The tuberous species, or common bitter vetch, or heath pea, *Orobus tuberosus*, grows wild in mountainous woods and pastures, affords to the hardy highlander both luxury and food, and may be regarded as a culinary plant of the Welsh and Scottish Highlands. Its root is creeping, knobbed, externally blackish, and internally sweet and nutritious; its stem is simple, erect, compressed, winged, and about a foot high; its leaves are alternate, smooth, darkish green, and compound, consisting of two or three pairs of elliptico-lanceolate leaflets, and a projecting axis; its flowers have a purple ground-colour, with brilliant variations of crimson, blue, and flesh-colour, and are produced in long-stalked, loose, axillary clusters; and its pods are long, cylindrical, and pendulous, and become black when ripe.

The sylvan species, *Orobus sylvaticus*, grows wild in the mountainous woods of Great Britain, and is particularly abundant in Cumberland and Wales. Its root is woody, tough, and deeply set in the soil; its stems are numerous, recumbent or spreading, hairy, somewhat branched, and about two feet in length; its leaves grow from the joints of the stems, and have each about ten or eleven pairs of ovate-lanceolate leaflets, ranged close to one another along the midrib; its floral footstalks rise from the wings of the leaves, and are three inches in length; its flowers grow in a close spike or cluster, are cream-coloured, crimson-streaked, and purple-tipped, and appear from May till July; and its pods are compressed, ovate-oblong, and comparatively shorter than those of most of the other species.

The Pyrenean species, *Orobus pyrenaicus*, grows wild on the Pyrenean mountains, and was introduced thence to Great Britain about the close of the 17th century. Several stems rise from one root, and are smooth, branched, and about two feet in height; each leaf consists of four pairs of spear-shaped leaflets, each of which has three longitudinal veins; the floral footstalks are long, and rise from the wings of the leaves; the flowers have a purple colour, are ranged in a loose spike toward the upper part of the stem, and appear in

May and June.—The other species at present grown most commonly in gardens are those designated *luteus*, *albus*, *vernus*, *varius*, and *lathyroides*.

BITUMEN. Another name for asphalt; but the term *bitumen* may rather be employed generically to denote the compounds of carbon and hydrogen with or without oxygen, existing in asphalt, petroleum, coal, &c., so that the terms bituminous slate, coal, &c., are properly employed, although their constituents are combined in varying proportions. For the chemical characters refer to ASPHALT, PETROLEUM. Bituminous substances are, amber, asphalt, berengelite, coal, elastic bitumen, fossil copal, guayaquillite, hartite, hatchetine, idrialin, ixolyte, middletonite, ozokerite, petroleum, retinasphalt, and rock tar.

Asphalt enters into the composition of some black varnishes, and rock-tar boiled to a certain consistency may be employed alone while hot, especially if some resin be fused with it. Bituminous mastic, or asphalt, has been extensively employed in France, and has received some attention for covering roofs, pavements, floors, and lining cisterns. A bituminous limestone is ground and added to one-fifth of its weight of asphaltum, fused in an iron kettle, and when sufficiently homogeneous it is spread over the surface to be covered. A mixture of coarse and fine pebbles, fragments of brick, stone, &c., are often introduced into the mass for pavements. Coal-tar yielding by evaporation a pitch resembling asphalt, but more brittle when cold, may be employed as a substitute for asphalt, mixed with lime, pounded brick, and stones. When asphalt is employed for the floor of a hall, or entrance, to which it is well adapted, it may be ornamented with any device by impressing in its surface while hot small pebbles of the same or different colours.

BITUMINOUS SHALE. Slates impregnated with bitumen, which is sometimes so abundant that they may be employed as fuel. The slates containing iron pyrites are also employed in the manufacture of alum. The bituminous impregnation of the copper-slate of Germany allows it to be treated metallurgically for copper, notwithstanding its small content of copper-pyrites.

BIXA. See *ANOTTA*.

BLACK. A colour caused by the refraction of all the rays of light. When all the rays are present or reflected, the effect is whiteness; and when all are absent or refracted, the effect is blackness.—A black colour in horses, especially a glossy jet black, well marked, and without much intermixture of white, is highly esteemed. Any considerable proportion of white, especially when it spreads round the eyes, or a great way up the legs, adds nothing to either goodness or beauty. The black horses of England have usually more white than the black horses of any other country, particularly those of Denmark, Holland, Spain, and Arabia. Yet a star or blaze

of white, or a white muzzle, or a tipping of one or more of the feet with white, always looks well and lively, and is regarded by some persons as an indication that the animal is better tempered than if he were wholly black. Some blackish horses have brown muzzles and brownish flanks, and are often called black browns; some have a lighter colour about the muzzle, and are called mealy-mouthed; and some have a white circle round their eyes, and sometimes more or less white upon the hips, and are called pigeon-eyed. Blackish horses which partake most of the brown admixture, are generally the strongest in constitution.

BLACK BENT. See *ALOPECTRUS*.

BLACKBERRY. See *CURRENT* and *BRAMBLE*.

BLACK BINDWEED. See *BINDWEED*.

BLACKBIRD,—scientifically *Merula vulgaris*. A well known singing-bird, of the merulidæ or thrush family. The male with his yellow bill, and jet black plumage, is so universally known in Britain as not to need description. The female has blackish brown bill and legs, brownish-black plumage above, and umber-brown plumage on the breast, the margin of each feather passing into greyish-white. The young have similar colours to those of the female; and the males acquire their yellow bill and jet black plumage only after the second moult. Albino blackbirds, or varieties of white and cream colours, are sometimes seen.

The blackbird is generally but not always shy. It frequents hedges, thickets, shrubberies, and large gardens, feeds on slugs, shell-snails, insects, pease, currants, and cherries, and, when surprised or disturbed, utters a sharp cry of alarm, and escapes to the shelter of the nearest dense foliage. It often makes much havoc in a garden, but it compensates for this, not alone by its rich song, but by its destruction of snails and slugs.—The blackbird begins early in spring to build its nest, and usually selects for it a thickset hedge, an isolated close bush, a low ivied tree, or any similar situation. It builds with mosses, root fibres, and small sticks, lays on an interior coat of mud plaster, and finishes with a lining of fine dry grass. The eggs are four or five in number, of a bluish green, variegated with darker tints; and two or sometimes three broods are hatched during the spring and summer.

BLACK CANKER. See *TURNIP-FLY*.

BLACKCAP,—scientifically *Curruca atricapilla*. A singing bird, of the sylviadæ or warbler family. It occurs throughout the most of Europe, particularly in the northern and eastern districts; and it arrives in Britain about the middle of April, and leaves about the end of September. It is inferior only to the nightingale in the richness of its melody, and is popularly called the mock nightingale in Norfolk and other parts of Britain. The male is nearly six inches in length, and about 4½ drachms in weight. His bill is brown; his irides, dark hazel; the upper part of his head,

black; the back of his neck, ashy brown; the upper parts of his body, grey with a tinge of green; his quills and tail, dusky and edged with dull green; his breast and belly, light ash colour; and his legs and feet, bluish grey or lead-colour. The female is larger than the male; her plumage is darker and more tinged with green; and the crown of her head is of an umber-brown or rusty colour. The young, when they leave the nest, have similar plumage to that of the female. The blackcap frequents hedges, orchards, and gardens, and builds its nest among brambles or nettles, or in a low bush. When singing in its wild state, it secretes itself among dense foliage, and is very rarely seen; and, like the nightingale, it prolongs its song far into the night. When caged, it soon learns the notes of the nightingale or the canary, has highly attractive properties as a mocking-bird, and is in high esteem for its melody.

BLACK CATTLE. See CATTLE.

BLACKCOCK, or BLACK GROUSE,—scientifically *Tetrao tetrix*. A large game bird of the tetraonidæ or grouse family. The male is popularly called blackcock and heathcock; the female is popularly called grey hen; the young birds are popularly called poults; and all have a prominent place in the popular designation of grouse. The blackcock is somewhat plentiful in Holland, France, and Germany; it abounds in Denmark, Sweden, Norway, and Russia; it occurs sparingly among the mountains of Wales, and the wild heaths of the southern and central counties of England; and it abounds among the mountains of Northumberland and of the highland districts of Scotland. This noble bird is the largest and most beautiful of British grouse, and a chief ornament of British ornithology. The male weighs about four pounds, and is larger than the female; his general colour is deep black; each wing is marked with a band of white; his upper surface glitters with brilliant steel blue and purple reflexions; and his tail is forked, and terminates in outward curls. The female weighs only about two pounds; her upper surface is orange brown, speckled and barred with black; her breast is chestnut brown, barred with black; her greater wing-coverts are tipped with white; and her tail is ferruginous, spotted with black, and slightly forked.

Selby says, respecting the haunts and habits of this bird, "The bases of the hills in heathy and mountainous districts, which are covered with a natural growth of birch, alder, and willow, and intersected by morasses clothed with long and coarse herbage, as well as the deep and wooded glens so frequently occurring in extensive wastes, are the situations best suited to the habits of these birds, and most favourable to their increase. During the months of autumn and winter, the males associate, and live in flocks, but separate in March or April; and, being polygamous, each individual chooses some particular station, from whence he drives all intruders, and for the

possession of which, when they are numerous, desperate contests often take place. At this station, he continues every morning during the pairing season, beginning at daybreak, to repeat his calls of invitation to the other sex. At this season, his plumage exhibits the richest glosses, and the red skin of his eyebrows assumes a superior intensity of colour. With the cause that urged their temporary separation, their animosity ceases; and the male birds again associate, and live harmoniously together. The female deposits her eggs in May; they are from six to ten in number, of a yellowish grey colour, blotched with reddish brown. The nest is of most artless construction, being composed of a few dried stems of grass, placed on the ground under the shelter of a tall tuft or low bush, and generally in marshy spots where long and coarse grasses abound. The young of both sexes at first resemble each other, and their plumage is that of the hen, with whom they continue till the autumnal moult takes place; at this time the males acquire the garb of the adult bird, and, quitting their female parent, join the societies of their own sex. The food of the black grouse, during the summer, chiefly consists of the seeds of some species of juncus, the tender shoots of heaths, and insects. In autumn, the crowberry or crawcrook, *Empetrum nigrum*, the cranberry, *Vaccinium oxycoccus*, the whortleberry, *Vaccinium vitis idæa*, and the trailing arbutus, *Arbutus uva ursi*, afford it a plentiful subsistence. In winter, and during severe and snowy weather, it eats the tops and buds of the birch and alder, as well as the embryo shoots of the fir tribe, which it is well enabled to obtain, as it is capable of perching upon trees without difficulty. At this season of the year, in situations where arable land is interspersed with the wild tracts it inhabits, descending into the stubble grounds, it feeds on grain."

BLACK CURRANT. See CURRANT.

BLACK DOLPHIN. See APHIA.

BLACK DYE. The basis of black dyes for all organic fabrics is the tannogallate of iron; but the modes of application vary with the nature of the fabric, whether silk, wool, or cotton. The finest blacks are obtained by a combination of colours; thus a rich black is imparted to wool by grounding it with a deep indigo-blue, then passing it through logwood, galls, or sumach, and finally through a bath of these with coppers and verdigris, or immediately through the latter.

BLACK FLY. See FLY.

BLACK-LEG, or LEG EVIL. A formidable disease in the legs and sometimes in the neck of sheep. It is frequent in the midland counties of England, and is called the wood-evil in Staffordshire. The hoof or the knee is usually the first seat of it; and this swells, and makes the sheep quite lame. The diseased limb is generally covered with small blisters, filled with a bluish fluid; and the skin is of the same colour, and soon breaks into ulcers. The part affected should be

cleared from wool, well cleansed with soapy water, and dressed with basilicon rendered caustic by the addition of a little red precipitate, or with any similar caustic ointment; or the sores may be thinly powdered with a little pulverized burnt alum, and the whole limb wrapped in a cloth thinly spread with the scab ointment.—When the disease attacks the neck, it causes the sheep to carry the neck awry; and it may be treated in a similar manner as when it attacks the legs.—The name black-leg is also one of several provincial designations given to inflammatory fever in the cow. See the articles FEVER and INFLAMMATION.

BLACKMUZZLE. A disease in the face of sheep. It is an erysipelatic eruption on the nose, and sometimes extends up the face. It resembles scab in outward appearance, but does not arise from the same cause, and is not contagious. In lambs, it has been ascribed to cutaneous affection in the teats or udder of the dam; but it is neither peculiar to lambs, nor of common occurrence at any age; yet as it is always limited to the face, and generally spreads from the nose, it probably arises from some cause connected with feeding. A mild mercurial ointment, holding in combination some resin and some Venice turpentine, will easily cure this disease.

BLACK OATS. See OATS.

BLACK PALMER. See TURNIP-FLY.

BLACKTHORN, or SLOE-TREE,—botanically *Prunus spinosa*. A large, rigid, spiny bush, bearing rosaceous flowers, and drupaceous plum-like fruit. It is a common indigenous plant throughout Great Britain, frequently growing in hedges, thickets, banks of streams, and road-side wastes, and generally known for its small, beautiful, austere drupes. It is quite equal in beauty to some of our highly esteemed ornamental shrubs; but is prevented, by its commonness, from being introduced to shrubberies, or even noticed as handsome. It usually grows to the height of about 15 feet; and it blooms in March and April, and matures its fruit toward the end of autumn. It has been frequently used for making quickset hedges; but, in consequence of its greater liability to fail, of its running more into the ground, of its greater tendency to expend its power in throwing up suckers, it is not so suitable for this purpose as the common hawthorn. Yet it serves much better, as a cut plant, for dead hedges or for filling gaps, both because it keeps longer fresh, and because it offers a firmer resistance to cattle. It has been regarded by some botanists as holding the same relation to all the varieties of the garden plum which the crab-tree holds to most of the cultivated varieties of the apple; but it is obviously an altogether distinct species from both the plum and the bullace. Its small glossy black drupes are greedily sought after by the children of the peasantry in many districts; but they are too intensely acidulous, and too astringent and austere, to be eatable by almost any adults, ex-

cept when cooked with a very large proportion of sugar. The juice of the fruit is said to be commonly employed in adulterating port-wine, or in making artificial imitations of it; and when inspissated over a slow fire, it serves as a substitute for catechu, and operates beneficially in checking such dysenteries as are not accompanied by inflammation. The dried leaves are said to be, in many instances, mixed up more or less with the tea of the shops.

BLACKWATER. A disease in sheep and in black cattle. Blackwater in sheep is supposed to be caused by rank pasturage, and is indicated by the discharge of a black and sometimes bloody serum from the kidneys; and when it proves fatal, a serum of the same kind is found in the stomach. The proper treatment for it is the administration of tonics and gentle aperients,—the tonics consisting of bark or steel, or of vitriolic acid in infusion of bark.—Blackwater in black cattle, and sometimes in sheep, is simply the concluding stage of the disease called redwater; and it cannot be made to yield to any known remedy, but ought to be prevented by a prompt and skilful treatment of the precurrent symptoms. “In the last stage of redwater,” remarks Mr. Thomson, “when the urine assumes a dark brown or black colour, no remedy seems to have any efficacy, the animal is sunk beyond recovery, the bowels lose their action, suppression of urine follows, the animal stretches itself out and dies, as if perfectly exhausted. It is the duty of the owner, therefore, to attend to this disease at its commencement, and pursue a determined course of practice.” See the article REDWATER.

BLADDER. The musculo-membranous bag in red-blooded animals, which serves as a temporary reservoir of the urine. It receives the urine, by constant droppings, through the ureters from the kidneys; and discharges it, by occasional evacuations, through the urethra. In quadrupeds, it has a pyriform shape, and is wholly surrounded with the serous lining of the abdomen; and, in general, it is smaller, stronger, and more muscular, in carnivorous than in graminivorous genera. In the male human subject, it is situated in the basin of the abdomen, immediately before the lower extremity of the intestines; in the female human subject, it is separated from the lower extremity of the intestines by the uterus; and in different individuals of both sexes and of various ages, it is much modified in both form and size, by the advance of age, by habits of living, and by the particular exercise of its own functions. In a general view, it changes from a pyriform shape in the infant to a short oval shape in the adult, lies lower in the basin of the abdomen in middle life than in youth, and in old age than in middle life, increases in capacity as life advances, is larger and has a greater transverse diameter in the female than in the male, is reducible by constant irritation to a habit of irretentiveness, and expansible by

frequent long retentions into an enlargement of size, and possesses an average capacity in adults of about a pint and a half.—The bladder, like other hollow viscera, consists of three layers, united to one another by cellular tissue: the outer layer is serous, and serves as a covering; the middle layer is muscular, and serves for the expulsive process in evacuation; and the inner layer is mucous, and contains a number of secretive glands to counteract or avert the acrid power of the urine. The wider region of the bladder is uppermost, and communicates with the kidneys by an exquisite contrivance, which allows the urine to percolate, and yet, in all healthy conditions of the system, is impassable by the blood; and the narrow region or neck has a fixed attachment to the urethra or conducting canal of evacuation, and is provided with a sphincter or circular muscle which remains closed during the period of retention, and relaxes to admit of evacuation. For notices of the diseases of the bladder in the live stock of the farm, see the articles INFLAMMATION, STONE, RUPTURE, INVERSION, and PROTRUSION.

BLADDER KETMIA,—botanically *Hibiscus trionum*. A curious ornamental hardy annual plant, of the mallow tribe. It is also popularly called Venice mallow and the Flower of an Hour. It grows wild in Italy, and was introduced thence to Great Britain about the close of the 16th century. Its stem is branching, about two feet high, and beset with numerous soft spines which elude the notice of a careless observer; its leaves are three-lobed, and cut almost to the midrib; its flowers stand on pretty long footstalks at the joints of the stem,—they have an inflated calyx, a many-leaved involucre, and an expanded corolla,—they are yellowish-brown in colour,—and, though each flower continues but a few hours open, a succession of them maintains a bloom from June till September; and its capsules are blunt, and have five many-seeded cells, filled with small, smooth, kidney-shaped seeds. The curious flowering habits of this plant give it the same kind of interest to an enlightened observer of the works of God, which is possessed by the singularly gorgeous bulbous plant, *Tigridia pavonia*. The seeds of it may be sown in either autumn or spring; and the young plants require little care, and will scarcely bear to be transplanted.—A co-species of the common bladder ketmia, *Hibiscus vesicarius*, bears popularly the name of African bladder ketmia, and very considerably resembles the preceding species, but is hairier, more erect, and more purplish in the stem, narrower and far less deeply cut in the leaf, and larger and more deeply coloured in the flower. This species also is an annual; and it was introduced from Africa to Britain in the early part of last century.

BLADDER-NUT,—botanically *Staphylea*. A small genus of ornamental shrubs, of the staff-tree tribe. The common or pinnate-leaved blad-

der-nut, *Staphylea pinnata*, grows wild in the woods of several parts of England and of a large portion of Europe, and is cultivated in gardens and shrubberies for the sake of its singular and very handsome appearance. Several shrubby stems arise from each root, and usually attain a height of from six to ten feet; the twigs are very pithy, and, when broken, emit a strong fragrance; the bark of the older branches is brown, of the younger a much lighter colour, and of both exceedingly smooth; the buds, in early winter, are large and turgid, as if ready to burst into shoots, and occasion the shrub, in its leafless season, to present a charming appearance of health, energy, and verdure; the leaves are lightish green, pinnated, consisting of five folioles, and resembling the pinnate leaves of some sorts of ash-tree; the folioles are oblong, pointed, tolerably large, arranged in two pairs and an odd one, and standing on rather long footstalks; the flowers have a whitish colour, are produced in long pendulous bunches from the wings of the leaves, and bloom from April till June; and the fruit or nuts look like comparatively large inflated bladders, and have a very singular and striking appearance in autumn. The nuts have a smooth exterior, and are used in Roman Catholic countries for the making of rosaries; and the seeds or kernels are eaten in some countries as food by poor persons, but, though at first sweetish, they have a nauseous gout and a squeamish or even emetic effect.

The three-leaved bladder-nut, *Staphylea trifolia*, is a native of North America, particularly of Virginia, and was introduced thence to Great Britain in 1640. It is as hardy as the common bladder-nut, and grows to about the same height; its older branches seem as if sprinkled with greyish spots; its younger branches have a yellowish and perfectly smooth bark; its buds swell early in winter, but are not so large or turgid as those of the common species; its leaves consist each of three folioles, and grow by threes on a footstalk; its folioles are light green, pretty large, oval, pointed, and serrated; its flower buds appear in early spring, and sometimes so early as January, yet do not unfold till May; its flowers have a white colour, are produced in long pendulous bunches from the sides of the branches, and bloom in May and June; and its fruit or nuts, like those of the common species, appear like large inflated bladders.—Both of these species may be propagated from either seeds, layers, or cuttings.—A hothouse species, growing usually to the height of 30 feet, and called the western bladder-nut, *Staphylea occidentalis*, was introduced to Great Britain from Jamaica in 1824. Two or three other species are known, but have not yet been introduced to Britain.

BLADDER-SENNA,—botanically *Colutea*. A small genus of hardy, deciduous, ornamental shrubs, of the pea tribe. The common species, *Colutea arborescens*, is a native of the south of

Europe, particularly of the district around Naples, and was introduced to Great Britain in 1568. It usually attains a height of about 10 or 12 feet; its branches have a whitish colour, and give it a unique appearance during winter; its leaves are pinnated, and consist of four or five pairs of oval and top-indented folioles, with a terminating odd one, and have a very pleasing appearance; its flowers are papilionaceous, numerous, clustered, and yellow, and they stand on long and slender footstalks, and bloom from June till August; and the pods are large and inflated like bladders, partially appear at the same time as the later flowers, and have an arresting effect upon the eye the first few times of their being seen. This plant is sufficiently scenic and beautiful of itself to secure esteem, and quite hardy enough to resist the damaging effects of our severest winters; yet, in order to be protected from fractures and splittings by high winds, it requires to be planted among other tall shrubs or low trees. It is said to have been cultivated by the ancient Greeks of the district around Athens for the fattening of sheep.

The oriental or bloody bladder-senna, *Colutea cruenta*, is a native of the Levant, and was introduced to Great Britain early in last century. It usually grows to the height of about five feet; its branches have a greyish colour; its leaves are pinnated, and consist of several pairs of small and obversely-cordated folioles, with a terminating odd one; and its flowers are scarlet or reddish, spotted with yellow, are produced in twos or threes on footstalks from the sides of the branches, and bloom in June and July. This plant is extremely hardy, and not so liable to be split or fractured as the common colutea.

The Aleppo or Pococke's bladder-senna, *Colutea halepica*, is also a native of the Levant, and was introduced to Britain about the middle of last century. It commonly attains a height of 6 or 7 feet, and differs from the common species in scarcely any other property or feature than mere size.—The intermediate bladder-senna, *Colutea media*, grows to the same height as the common kind, but has orange-coloured flowers.—The Nepal species, *Colutea nepalensis*, was introduced to Britain from Nepal about twenty-five years ago; and it grows to the height of 5 or 6 feet, and produces a yellow flower in August and September.

BLADE. The spire of a small grass plant, before sending up the flower-stem, or the green shoot of a corn plant rising from the seed; also, the sharp face or striking part of an instrument or a weapon.

BLAIN. A disease of black cattle and sheep. It is sometimes called inflammation of the tongue; yet though it seems always to have its origin or its chief seat in the membrane of the mouth beneath or above the tongue, it extends its ravages widely over the system, and involves inflammation and gangrene of the œsophagus, the paunch,

and the abomasum. Frequent popular names of it are hawker, glossanthrox, and gargyse. It is a disease of both great virulence and very rapid action,—sometimes proving fatal in a single day; and it ought not, in any case, to be trifled with for even one moment. It occurs at all seasons, and on all sorts of pastures; but is most frequent in sultry summer weather, on rich pastures, in low and moist situations. It seems to be very often induced by the contraction of a common cold, while the vascular system is full of rich blood, or while the animals are in a high condition; yet some persons have ascribed it to a sudden rising of the blood, and others to the licking up of a small red worm. An animal, on contracting it, appears dull and languid; the eyes are inflamed, and make a trickling discharge of water; a swelling appears round the eyes, and sometimes on other parts of the body; the pulse is accelerated; the flanks exhibit more or less of a heaving motion; the bowels, in some cases, are constipated; but, above all, and as the characteristic symptoms of the disorder, blisters are formed under the tongue or at the back part of the mouth. When the disease is suffered to advance without a proper and prompt check, or when its earlier stages happen to escape observation, a copious discharge of saliva flows from the mouth, often mixed with purulent, bloody and fetid matter, the tongue is much and rapidly enlarged, and the animal suffers languor and exhaustion, and seems in hazard of suffocation. A proper and very expeditious remedy is thoroughly to cut the blisters in the mouth; and if much fever be present, five or six quarts of blood should be taken away, an aperient drink may be given, and the mouth may be washed with a solution of one drachm of chloride of lime in a quart of water. The cutting of the blisters ought to be a perfectly simple operation, and totally unaccompanied by operations with sticks, tar, or any other appliances. When the discharge from the cut blisters ceases to be very fetid, the wash with the solution of chlorine of lime should be substituted by one consisting of equal parts of water and tincture of myrrh. If the fever continue, a drink should be given night and morning, consisting of one drachm of emetic tartar, half a drachm of pulverized foxglove, three drachms of saltpetre, and a quart of pretty thick gruel; if debility and want of appetite remain after the fever is subdued, a drink may be given once or even twice a-day, consisting of two drachms of gentian, one drachm of ginger, one drachm of tartrate of iron, and a pint of gruel; and till the animal acquire appetite for ordinary food, or soundness of mouth for using it, thin gruel ought to be kept within its reach, and a proper quantity of thick gruel given it with the horn. The disease, however contracted, may infect other cattle; and the purulent discharges of it, if falling on any skinless part of the human body, occasion such troublesome ulcers as can-

not well be reduced without the application of lunar caustic. All cattle, therefore, ought to be kept at a distance from a diseased animal; and the human attendant on the latter ought thoroughly to protect any spot of his hands which may be sore or scratched. Sheep affected with blain require to be treated in nearly the same manner as cattle; only the proportion or strength of medicated drinks must be reduced to suit the weaker power of the animal.—*Clater's Cattle Doctor*.—*Lisle's Husbandry*.—*Spooner on Sheep*.—*Youatt on Cattle*.

BLANCHING. A horticultural operation for rendering the stems and leaves of certain esculent plants mildly flavoured, crisp, and tender. Plants which grow in the dark are destitute of verdure and of the stronger kinds of odours, which belong to plants of the same species grown in the light; they are also much less combustible, and comparatively free from oils and resins; and, if they are of the group whose leaves or roots are eaten raw, they are more saccharine, less acrid, and, in all respects more agreeable to the palate. A method of blanching practised upon lettuces and upon such of the cabbage genus as do not boll, is to tie the leaves close up in summer; and this method both improves the flavour of the leaves, and accelerates the period of their fitness for use. A method practised upon celery, endive, and dandelion, is to earth them up to their top in winter; and this not only blanches them, but protects them from frost. A method practised with leeks, is to transplant them, when about six inches high, into deep and half-open dibble-holes, cutting away a portion of both the roots and the tops of the plants; and this both adds greatly to the length of the blanched portion of the head, and very materially cleanses it from the natural pungency and coarseness of its flavour. A diseased whiteness in plants or parts of plants which ought to be verdant is somewhat distinct from blanching, and obtains the name of etiolation. See the article **ETIOLATION**.

BLAST. Blight in vegetables, or hoove in sheep and black cattle. See the articles **BLIGHT** and **HOOVE**.

BLASTING OF ROCKS. An operation of great importance in the formation of roads, or in the breaking up of uncultivated ground. The process of blasting rocks, or stones, consists in boring a cylindrical hole, about 10 or 12 inches deep, in the rock, by means of a chisel for that purpose. The lower part of this hole is filled with gunpowder. The upper part of the hole is then filled up with fragments of stone, firmly rammed together; a hole being left through these materials, by the insertion of an iron rod, which is turned round during the operation of ramming. This hole is next filled with powder, and a match is applied to it in such a manner, that the operator has time to run out of the reach of the fragments of the rock. This process, which is both tedious and dangerous, is now

abandoned for one which is more simple and effectual, and which consists merely in introducing a straw, filled with gunpowder, among the powder at the bottom of the cylindrical hole in the rock, and filling the rest of the cylindrical hole with loose sand. By applying a match to the gunpowder in the straw, an explosion takes place; and, instead of the loose sand being driven out of the cylindrical hole, as might naturally be expected, the rock is completely shivered in pieces.

BLATTARIA. See **MULLEIN**.

BLAZE. A white mark in a horse's face.

BLEA. An obsolete or merely provincial name for the alburnum of a tree; also a provincial name for a leaden or dusky blue colour.

BLEABERRY. See **WHORTLEBERRY**.

BLEACHING. The destruction or removal of colour from an organic substance, the main mass of which is white, is termed bleaching. Thus yellow bees' wax, by a careful exposure to the atmosphere, will eventually become white, without any other material change in its properties, as the yellow colouring matter does not necessarily belong to it. In this sense, some of the discharges employed in calico-printing are bleaching agents, but we propose confining ourselves in the present article to the methods of removing colour from organic fibre, such as cotton, linen, &c., either to prepare it for receiving other colours by dyeing or printing, or to throw it into commerce with a pure white colour. The methods formerly pursued, and still practised, consist in exposing cotton, &c., to the action of atmospheric agents or sulphurous acid derived from burning sulphur, assisted by soap and alkali, but within the present century chlorine has become the principal bleaching agent, especially for cotton goods. We may remark in passing, that the use of chlorine for bleaching has been one principal cause of the present extensive production and consumption of cotton goods, even independently of the improvements in machinery which have distinguished the last century.

I. ATMOSPHERIC BLEACHING.

It is only employed for linen and cotton, the latter of which is the simpler and easier.

Cotton.—Cotton contains naturally a little colouring matter, which is easily bleached, but as this operation is performed on the spun or woven goods, the weaver's dressing, grease, and other impurities must be removed at the same time. The process consists, 1st, in steeping the cotton in water (not too cold), in order to destroy the weaver's dressing by *fermentation*, which takes place in from 1 to 6 days, according to the weather and the kind of goods, when it is thoroughly cleansed in the dash-wheel, or otherwise.

The goods are then spread out on the grass, and exposed for 2 to 6 days to the action of the sun, air, and moisture, sprinkling them occasionally with water, if necessary; and then *bucket*

with a hot alkaline lye. The process of exposing and bucking is repeated two or three times until the fibre is white.

Cleansing—the third process—is effected by laying the goods in lukewarm water acidulated with sulphuric acid, and finally washing them thoroughly at the dash-wheel. Cotton loses about 5 per cent. of its weight in bleaching.

It is remarkable that we cannot yet explain the manner in which bleaching is performed, whatever process is pursued. In the present case, it is probable that air and moisture (arising from rain, dew, or artificial sprinkling), influenced by solar light, oxidize the colour on the fibre, even without the assistance of alkali. But by exposure, the colour becomes more soluble in alkali, and hence each successive bucking removes the portion decomposed. The final *souring* removes any earthy matters which may have become attached to the fibre during the process, and neutralizes the last portions of alkali, which would have been difficult to remove by water alone. By the preparatory fermentation, the weaver's paste, containing starch and gluten, undergoes successively the saccharine, vinous, and acetous fermentation, by which gluten and other substances are dissolved in the acetic acid generated and the fibre becomes swollen. Care must be taken to stop the operation before the putrefactive process commences, which would injure the fibre.

The above operations are sometimes slightly varied. To hasten and complete the fermentation, bran or rye-flour may be added to the steeping water. The addition of alkali or lime (which is sometimes used) lengthens the fermentation, and should only be used where it is too rapid. If the goods be greasy, fermentation, being injurious, is omitted, and they are then merely boiled some hours in water, and washed. A bath of milk of lime is sometimes given immediately after fermentation and before bucking, which materially assists the bleaching, but it acts injuriously, unless all the weaver's paste has been destroyed by fermentation and washing. At the present time nearly all the cotton of commerce is bleached by chlorine, the atmospheric agents being employed as very subordinate assistants.

Linen.—Flax, when not *retted*, contains but little colouring matter, which can be removed by a few washings with soap and alkali, but the putrefactive process of retting produces a colour which requires a tedious series of operations to remove. To employ the chlorine process alone would undoubtedly shorten the time of bleaching, but the colour adheres so pertinaciously to the fibre, and so obstinately resists decomposition, that the strength of the fibre would be impaired. Hence a tedious atmospheric bleaching is always resorted to for linen, combined to a limited extent with chlorine. Even with this process, the long exposure to light, air, and moisture, the oft

repeated operations necessarily weaken the fibre, as may be inferred from the loss by bleaching, which may often amount to one-third or 30 per cent. of the weight.

The process without chlorine, as practised in Silesia and Bohemia, consists of, 1st, steeping, exposure to light, &c., and washing; 2d, bucking, exposure, and washing.

After fermentation and washing, the linen is steeped for 12 hours in a solution of potash or waste lye (1000 water to 1 or $1\frac{1}{2}$ lbs. potash) at the temperature of 70° to 80° , wrung out, and, without being washed, spread out upon grass to the action of the air until dry, and for several hours after. It is again steeped and exposed to the air, the temperature of the solution being gradually raised at the last steeping, but not above 170° . The steeping and exposure being repeated 2 to 5 times, the linen is washed in the dash-wheel, steeped again 1 to 3 times in alkaline solution, and then properly bucked.

The bucking solution contains at first 4 lbs. potash to 1000 water, and the temperature beginning with 95° is increased during 18 hours to boiling. The linen is then exposed to the air as before, while still hot, and wet with the solution until fully dry. This alternate bucking and exposure is repeated 8 or 10 times, the alkaline solutions being rendered a little stronger, but not exceeding 4 lbs. to the 1000 of water; the linen is then washed in the dash-wheel. It is again steeped and again bucked several times, the liquors employed being weaker, and the linen exposed on the grass for a longer time, and being kept moist by sprinkling.

Thus, after steeping 8 to 10 times, bucking 12 to 15 times, and as often exposing it, which operations require 60 to 70 days, the linen is sufficiently white for domestic use. But for a pure white, it is next passed through a bath acidulated with sulphuric acid, steeped, bucked 2 to 3 times more, and exposed, again passed through the acid, and finally cleansed in the dash-wheel. The whole process requires 80 to 90 days, and the linen loses from 12 to 25 per cent. of its weight, the less in proportion to its fineness.

The theory of the above process may be thus explained:—The stem of flax and hemp consists of the inner woody part, or boon, surrounded by the harl like a fibrous sheath, and externally the cuticle. The harl is united with the boon and cuticle by a cement of gluten, gum, resin, &c., which is destroyed by retting (putrefaction in water or moist air). When the retting is completed, the harl is easily separated from the others, but beside its natural colour, it has received a deposit of a humus-like substance, of a more or less dark colour, which is insoluble in boiling water, in acids, and alkalies. But when it has been exposed to the air, light, and moisture, it becomes soluble in caustic and carbonated alkali. The bleaching succeeds much better when the fibre, imbued with alkali, is ex-

posed to the air, from which we infer that the alkali induces the formation of an acid from the colouring matter, but it is unknown whether it acts by forming carbonic or a ternary organic acid. The operations consist simply of the decomposition of the colour and its removal by alkali. But as the colour exists in every part of the bundles of fibres, and in considerable quantity, its complete removal is only effected by frequent repetition of the operations.

II. BLEACHING BY CHLORINE.

This powerful bleaching agent might be and has been employed both in its gaseous state and in solution in water, but the former is inconvenient in use, acts unequally on the goods, and is too dangerous to the health of operatives. The latter is more easily regulated and less injurious, but the chlorohydric acid produced during bleaching may be a source of inconvenience. Hence chlorited alkali is preferred, as it develops chlorine in proportion as acid is made to act on it, is not detrimental to health, and offers alkaline base to neutralize the generated muriatic acid. Chloride of lime or potassa is employed, the former most usually. One pt. dry chloride of lime, as far as regards its bleaching salt, dissolves in 10 pts. water, but this would be too strong for bleaching white grounds, and is only used for printing; this bleaching liquid may therefore be diluted with 5 or 10 times as much water. Chlorine bleaching is performed on cotton, linen, and rags.

Cotton—Cotton bleached by chlorine is subjected to the successive action of, 1st. soda-lye, 2d, chloride of lime, 3d, sulphuric acid, all employed in dilute solutions. To remove the weaver's dressing, either fermentation or boiling with milk of lime and souring are employed. If the goods are greasy, fermentation is abandoned, and, indeed, boiling water and the lime-bath forms at present the usual preparatory step. The succession of separate processes is various, according to the nature of the goods, or their destined object, and according to the pleasure or experience of the bleacher. The following tabular views will present some of these differences:

- 1.—Preparatory.
 - a. Washing.
 - b. Boiling in lime water.
 - c. Washing.
 - d. Souring.
 - e. Washing.
 - 2.—Bleaching.
 - a. Soaking in soda-lye.
 - b. Washing.
 - c. Chemicking.
 - d. Souring.
 - e. Washing.
 - 3.—The same as 2 repeated throughout.
 - 4.—Finishing.
 - a. Soaking in hot water.
 - b. Squeezing and drying.
-
- 1.—Preparatory.
 - a. Boiling with water.

6. Washing.
 - c. Boiling in milk of lime.
 - d. Washing.
- 2.—Bleaching.
 - a. Bucking in soda-lye.
 - b. Exposing on grass.
 - c. Washing.
 - 3.—Same as 2 repeated once or twice.
 - 4.—Finishing.
 - a. Souring.
 - b. Washing.
-
- 1.—Preparatory.
 - a. Steeping in water.
 - b. Fermentation.
 - c. Washing.
 - 2.—Bleaching.
 - a. Bucking with weak caustic potash.
 - b. Bucking with stronger lye.
 - c. Chemicking.
 - d. Souring.
 - e. Washing.
 - 3.—The same as 2 repeated, or
 - a. Exposure on grass.
 - b. Souring.
 - c. Washing.

In the preparatory process, the first steeping in hot or cold water removes whatever is soluble in water. The lime then dissolves the gluten of the paste, forms a lime-soap with grease, or the gluten is destroyed by fermentation. If the goods had been greasy, the fatty matter is removed by the following bucking in soda-lye. Thus cleansed, the goods are steeped for some hours in the bath of chloride of lime, or *chemicked*. The quantity of the bleaching salt varies in different establishments, and according to the goods; 100 lbs. of the latter require about 50 lbs. of chloride, which is first made into a paste with water, and then added to about 300 gallons water. From the chloride the goods are immediately transferred to the *sour*, or dilute sulphuric acid, consisting of one gallon of oil of vitriol to from 20 to 40 of water, in which they remain a shorter or longer time in proportion to the strength of the acid. The action of the acid is to develop chlorine from the bleaching salt with which the goods are imbued, and to neutralize and remove lime. The goods are washed, and the bleaching repeated, either by chemicking and souring, or by alkali and exposure, until sufficiently white.

Chloride of lime may be simply viewed without reference to chemical theories, as chlorine gas combined with lime, so that the sulphuric acid, by combining with the lime, expels the chlorine, which is the cause of the destruction of the colouring matter in goods. But in what manner it decomposes the colour has not been determined experimentally, although all chemists are agreed that it is by its affinity for hydrogen, forming chlorohydric acid. Berzelius holds that chlorine, with the action of light, or from the presence of oxidable substances, decomposes water, forming muriatic acid, while the oxygen set free combines with another portion of chlorine to chlorous acid, or with water to binoxide of hy-

drogen; either of these yields up its oxygen to the colour until all the chlorine is changed into muriatic acid. Others believe that the chlorine combines directly with the hydrogen of the colour to muriatic acid; while some think it is substituted for the hydrogen. In any case, whether by oxidation, dehydrogenation, or substitution, the colour is destroyed. But from the powerful action of chlorine, even when dilute, it cannot be continued for a long time, as it would destroy the fibre, as well as the colour. Hence it is well adapted to cotton, whose colour is easily removed, but it can only be employed as an assistant in linen bleaching, whose colour more stubbornly resists decomposition. Warmth assists the action of chlorine, but is apt to be injurious to the fibre. A little dilute sulphuric acid may be added to the chloride of lime when largely diluted with water, and is thought to hasten its action, from the formation of chlorite of lime or oxygenated water, which remain in the bath when dilute and cold. For it has been found that even when a sufficient quantity of acid is added to decompose nearly all the bleaching salt, in a dilute and cold bath, its bleaching power is undiminished or imperceptibly weakened after the lapse of some days.

Linen.—Chlorine and souring, with sulphuric acid, have been latterly employed as an aid to the bleaching process of linen, and it would seem without injury to the fibre, which loses even less in weight than by the older process. The first steps are usually the same to about the 5th bucking, as shown in the following view of the process.

- 1, 2. Steeping in weak, warm lye.
- 3 to 7. Bucking, exposure, and washing.
8. Souring 12 hours in dilute acid, and washing.
- 9, 10. Steeping, bucking, &c.
11. Chemicking (chloride of lime), washing.
12. Souring and washing.
13. Bucking and exposure.
14. Chemicking and washing.
15. Souring and washing.
16. Bucking and exposure.
17. Souring and washing.
18. Washed with soap, and thoroughly with water.

The *chemic* or bath of chloride of lime is sometimes employed but once, sometimes three times. Chloride of soda or potassa is frequently employed instead of lime. The linen is washed after being in the chlorine-bath, and previous to souring, for immediate souring after the bleaching salt weakens the fibre. The action is similar to that above, with this difference, that the chlorine is developed more slowly. By the assistance of chlorine the time of bleaching linen is shortened some 3 to 5 weeks.

Rags.—The sorted, cut, and dusted rags are thrown into a tight vat, in which they are boiled with milk of lime containing a little alkali to remove grease, loosen colours, &c., or interstratified with dry lime and a little alkali, are steamed. They are then washed in the engine and reduced to *half-stuff*, when the chloride of lime is thrown in and worked through the mass by the engine,

the gates being closed. Dilute oil of vitriol is then let on the mixture and worked through in order to develop chlorine; after which the gates are opened, and, while reducing to fine pulp, the current of water removes the salts of lime. A solution strong enough to bleach dark-coloured rags must weaken the fibre, to avoid which a second bath of chloride may be resorted to; by washing off the salts from the first, then passing a little alkali through, and adding chloride afresh, or immediately adding the latter after washing, and then souring and washing as before. When chloride is applied in two portions, a small quantity is used with less injury to the fibre. Muriatic acid may be substituted advantageously for sulphuric, from the greater solubility of chlorides over sulphates. To prevent paper from becoming yellow, after bleaching and washing off the salts of lime, work a little alkali through the engine, with the gates down, and wash off the residue with water. The principles are the same as explained above under the bleaching of cotton by chlorine.

III. SULPHUROUS BLEACHING.

The vapour of burning sulphur is employed for removing colour from, or whitening wool, silk, and straw.

Wool.—Neither chlorine nor atmospheric bleaching can be employed for wool, as they rather render it dirty yellow. Wool contains a greasy coating, called the *yolk*, arising from the sweat of sheep, which is composed of a potash soap, together with acetate, carbonate, and muriate of potassa, a salt of lime, and an animal substance, the cause of its peculiar odour. The greater part of the yolk is soluble in water, but alkali removes it more perfectly. It is usual to employ putrid human urine, diluted with 4 to 8 times as much water, warmed to 100° or a little more, into which the wool is steeped for a short time, taken out, drained, and washed. The yolk may also be removed by weak and warm soap-water, or a little very dilute carbonated or caustic potassa or soda, or both soap and a little alkali; but the use of alkali requires more care, lest the fibre should be attacked, and hence it is only used, if at all, for inferior kinds of wool. A continuance in the urine or alkali, and too high a temperature, injure woollen fibre. The loose wool should not be worked about too much, which would cause it to felt, and thereby injure it for spinning.

After washing, the bleaching is performed by exposing the moistened wool in a close chamber to the vapour of burning sulphur, or it is steeped in water acidulated by sulphurous acid. The latter solution is made by passing sulphurous acid gas, derived from oil of vitriol and charcoal, into water. See SULPHUR. Sulphuring by the gas of burning sulphur is more commonly practised, and is more economical, but the liquid acid, while it bleaches equally well, renders the wool less harsh and crisp, and does not injure

the fibre. It is exposed to the gas for 12 to 24 hours, to the liquid acid 24 to 48 hours. The harshness derived from sulphuring is removed by soaking the wool in a warm and weak bath of potash-soap, wringing, and drying. To impart a more brilliant white, the bleached wool is sometimes dipped into chalk-water.

Wool is sometimes bleached in the fleece, and sometimes in the yarn. Both yarn and cloth are cleansed in a manner similar to the above by alkali or soap, in order to remove grease and glutinous matter derived during spinning and weaving. Cloths may be cleansed in the wash-stocks, with fuller's earth, or a soap containing it.

Silk.—The bleaching of silk is of a simple nature. This fibre is coated with a gelatinous substance, a little wax, oil, and generally a yellow colouring matter; and is therefore essentially different from *gum*, as it is usually called. The gluey material, often constituting 24 per cent. of the weight of the silk, is soluble in water, scarcely in boiling alcohol, precipitable by tincture of galls, putrefies like animal matter, and its odour, when heated, indicates the presence of nitrogen. The yellow colouring substance, constituting nearly 2 per cent. of the silk, is of a resinous character, insoluble in water, very soluble in alcohol, scarcely soluble in cold, more in warm alkali, and still more in a hot solution of soap, is decolourized by chlorine, sulphurous acid, and in a few days by the atmosphere.

The coating imparts a stiffness and elasticity to silk, which must be removed in order to impart to it its requisite softness and lustre. Although alkali has been proposed and employed to remove the coating, it is found that scouring by soap, used long since, cannot be well superseded. From 30 to 40 lbs. of soap to 100 lbs. of silk are usually required. The greater part of the soap is dissolved in boiling water, and when cooled a little, the silk is hung over and partly immersed in the solution, which is maintained below a boiling heat, until the immersed part has attained its requisite whiteness and softness, when the other portion is next introduced in like manner. After being wrung out it is next put into bags, which are introduced into a weaker solution of soap, in which they are boiled for an hour or more. For silks designed to receive dark dyes 20 to 25 lbs. soap will be sufficient.

Silks designed to be of a pure white are subjected to the action of sulphurous acid by exposing them in a sulphur chamber to the fumes of burning sulphur, while still moist with soap-water. After sulphuring, they are washed, and passed through a warm soap-bath, in order to remove the sulphurous odour and restore their pliancy. Silks designed for blonds, gauzes, &c., are merely stripped of their yellowish colour by steeping them for two days in alcohol with $\frac{1}{4}$ as much muriatic acid; a process proposed by Beaume, which can be conducted economically, since a large proportion of the alcohol may be recovered

by distillation after neutralizing the muriatic acid by chalk or limestone. Alcohol removes colour, wax, &c., without touching the gelatine.

Straw.—A careful culture insures a requisite degree of fineness and firmness in the material, but for most purposes the colour must be diminished or removed. This may be done by chlorine, sulphurous acid, alkali, or atmospheric agents, but a violent process injures the fibrous texture. It may be steeped in pure fresh water for several weeks, exposed to the air, and then sulphured. According to Kurrer, it may be perfectly whitened by repeated steeping in boiling water and very weak alkali, which removes all soluble matter, then treated alternately with very dilute solutions of chloride of lime and sulphurous acid vapour, finally washed and dried in the sun. The process is tedious, but is said to remove the varnish which makes the natural straw brittle, and to render the fibre brilliant, white, and pliant.

It is even more difficult to explain the bleaching process by means of sulphurous acid than that by chlorine. It is generally assumed that the acid combines directly with the colour, without either giving or receiving oxygen, and forms a colourless or slightly coloured compound with it; for by the action of alkali or a stronger acid, the original colour is restored; and hence, also, the colour reappears on sulphured goods in the lapse of time by the gradual dissipation of sulphurous acid. The action of alkali in the above operations with wool, silk, and straw, depends simply on the solubility of the colouring or other matters in the alkaline solution.

IV. DISCHARGES.

There are many operations practised by the calico-printer, which may be termed bleaching, although they consist only in a topical removal or discharge of colour. Thus chromic acid, or bichromate of potassa, or the chlorides of tin are employed to discharge colours, but their action has not been minutely studied. It is probable that chromic acid yields up oxygen, destroying the colour by oxidation, and that the tin-bases form with the colouring matters compounds possessing little or no colour. But their action is different on different colours, and the protoxide of tin decomposes some colours by abstracting oxygen. In short, wherever we destroy colour, with the view of obtaining a white basis or ground, it is, strictly speaking, a bleaching operation. Thus a liquid may be decolourized by passing it through animal black, which absorbs the colouring matter. Some oily substances may be whitened by sulphuric acid, and some again by nitric acid, the former carbonizing, the latter oxidizing the colouring substance.

BLEACHING POWDER. The most important of the bleaching salts. Its manufacture depends on the absorption of chlorine gas by slacked lime, and consists: 1st, of the preparation of

lime; 2d, of that of chlorine; and, 3d, of the combining the two together.

1. *Lime*.—Limestones frequently contain iron, clay, and magnesia. Such are not well adapted to the manufacture of bleaching powder. Supposing the limestone to be of the best kind, and well burned, the operation of slacking requires some attention, for just so much water should be used as is sufficient to cause the quick-lime to fall to a fine flour. It is likewise important that the lime should be fresh, for otherwise it will have absorbed carbonic acid from the air and have become proportionally injured. In order to effect the perfect slacking, it is perhaps better to add a little less than a little too much water.

2. *Chlorine*.—This gas may be made either with black oxide of manganese and muriatic acid, or with the same oxide, and common salt with sulphuric acid. The manganese ore should contain as much pyrolusite and as little manginite as possible, since the former contains much more oxygen, which is required to oxidize the chlorohydric acid, and develop chlorine. The ore is reduced by calculation to binoxide. The ore is coarsely pulverized, for if in fine powder it is apt to form a compact mass at the bottom of the vessel for generating chlorine. For every 44 pts. of binoxide present in the ore, 58 pts. dry common salt are required, which are well mixed with the ore, and the whole thrown into a leaden vessel or generator; 140 pts. sulphuric acid, diluted with as much water, are then poured into the generator.

Four days are required, at the ordinary rate of working, for making good marketable bleaching-powder. A more rapid formation would endanger an elevation of temperature, productive of muriate of lime, at the expense of the bleaching quality. But skilful manufacturers use an alternating process, by piling up the wooden trays containing slacked lime only in alternate shelves in each column. At the end of the two days the distillation is intermitted, and the chamber is laid open. After two hours the workman enters, to introduce the alternate trays covered with fresh hydrate of lime, and at the same time rakes up thoroughly the half-formed chloride in all the others. The door is then secured, and the chamber, after being filled for two days more with chlorine, is again opened, to allow the first set of trays to be removed, and to be replaced by others, containing fresh hydrate, as before.

A good dry chloride of lime should be a white, uniform powder, possessing a faint odour of chlorine, *slowly* deliquescent in the air, forming a smooth paste with a little water, and dissolving in 20 pts. water with little residue, which solution should react alkaline. It should always have an excess of lime to protect it as far as possible from decomposition, and to neutralize free muriatic acid, which may be generated.

A liquid chloride is often preferred to the dry powder by calico-printers, especially where it is

manufactured in their own establishment. The arrangement above given may be employed for liquid chloride by passing the chlorine through tubes into milk of lime, consisting of 3 or more pts. lime to 100 water. The tubes should not dip deeply in the liquid, and the milk should be stirred up frequently. This solution of chloride tests stronger than the dry chloride from an equal quantity of lime, but, per contra, it is more liable to decomposition and must be used a short time after its preparation.

BLEEDING. The surgical letting of blood, for the alleviation or cure of disease. It is one of the readiest and most powerful remedies for the cure of various disorders, particularly those of the inflammatory class; yet though one of the simplest, most common, and most useful of remedial operations, it is very often both unseasonably and bunglingly performed. In all acute and rapid diseases, whether in the horse, the cow, or other valuable domestic animals, it is of the greatest importance, and ought in every case to be practised. In colds and inflammation of the lungs, it is always required, and is the principal remedy which can be used. In colic, suppression of urine, and inflammation of the bowels, it cannot do harm but is generally serviceable, and ought always to be applied. In inflammation of the eyes, the brain, or any other organ, whether occasioned by external or by internal causes, it is invariably suitable and ought to be promptly practised.

In the case of neat cattle, in particular, all swellings of the joints and all inflammatory diseases, no matter of what organ or from what cause, may be reduced by general bleeding; blain may be attacked by general, but more successfully by local bleeding; enlargement of the glands of the throat or of those between the jaws, should be reduced by bleeding in order to arrest consumption or other dangerous diseases of the lungs; feverishness or constipation as accompaniments of the yellows ought to be attacked by bleeding; contusions on the head or any wounds or bruises whatever which are likely to occasion inflammation involve a necessity for bleeding; and violent cold or catarrh which resists the power of a few antifebrile drinks, may be cured by bleeding.

Horses which stand much in the stable and are full fed have greater need of bleeding under any ailment than such as enjoy daily exercise; and when their eyes are heavy and inflamed, or when their lips or the interior parts of their mouth are unduly red, or when they mangle their hay and seem unusually heated, they are in particular need both of being bled and of having their diet lowered. The bleeding of young horses when they are shedding their teeth, relieves their pain and frees them from feverish heats. Bleeding is sometimes desirable in spring to decrease the ardour and strength which then characterize the blood; and it is sometimes necessary in sum-

mer for reducing excessive heats and preventing serious fevers. Some farriers, by way of averting disease, and maintaining an easy and healthful circulation, draw off a small quantity of blood, not much or at all exceeding a pint, three or four times a-year. But frequent bleeding creates a plethoric habit, and cannot without great danger be discontinued, and sometimes issues in a mischievous diminution of the animal's strength, or an almost ruinous irritation of the particular veins which are opened. The cases however which most require bleeding in horses, are colds, fevers of almost all kinds, falls, severe bruises, wands of the eyes, strains in hard riding or drawing, and all other accidents where a stagnation of the blood may be suddenly expected, or where the small vessels may be broken and the blood extravasated. Those horses which refuse their food after riding or any sort of work, require to be bled more frequently than others, to prevent fevers and inward inflammations of the lungs, the liver, or any of the principal viscera. Horses just recovered from purging at grass, and beginning to gather flesh, or horses upon any unusual pasture, and contracting a heavy appearance about the eyes, sometimes require to be bled. When any epidemic appears among horses, the bleeding of the sound animals may possibly act as a preventative; and if the epidemic continue for a considerable time, the bleeding, in very moderate quantity, may be repeated; yet a much safer and more rational preventative of contagion is the prompt and continued separation of the uninfected animals from the infected.

Local bleeding is the letting of blood for the relief of some one part of the body; general bleeding is the letting of blood for the relief of the whole system; and the former, as its name implies, draws off blood from the small vessels of the part, while the latter draws it off from a great or leading vein. An opinion was formerly entertained that general bleeding was more effective from certain great veins than from others; but this opinion is now quite laid aside. The most convenient are the veins of the neck, of the arm, or of the thigh,—particularly the first; yet other great veins are altogether as suitable. In all diseases of the head, and in all fevers and general inflammations, the jugular vein is peculiarly fit, at once from its situation, its size, and the facility with which it can be cut. In local inflammations, any of the adjacent superficial veins will suit. In diseases of the hinder extremity, the saphoena or thigh vein is the best. In affections of the shoulder or of the fore-leg, the plate or arm vein is preferable. In diseases of the foot, the coronet but especially the toe is suitable.

Various kinds of lancets and phleemes are used for performing the operation; but in all ordinary bleeding of horses or cattle, the common phleme is the safest instrument, the most effective, and the most easily used. It is more certain than the lancet in the extent of the wound which it

makes; and it can be applied with far less risk of accident or mismanagement; for it needs only to be placed with its star fairly upon the part of the vein to be cut, and to be smartly struck directly above the star with a blood-stick or piece of wood. The size of the star insures a sufficient opening; and the blunted part or blade of the phleme prevents it from going too deep. The spring phleme is not so facile in operation as the common one, and ought never to be used by an inexperienced operator. The lancet, in the hands of a novice, is not a little dangerous; and, even in the hands of a skilful operator, cannot be regulated with precision. The resistance of the integuments, the restlessness of the animal, and the depth of thrust requisite to make a proper incision, all endanger the success of the operation; and very experienced veterinary surgeons have been known, when using the lancet, to wound the carotid artery. In bleeding sheep, dogs, and small cattle, however, the lancet is the most handy instrument.

A horse about to be bled is blindfolded on the side on which the operation is to be performed, or his head is turned and held well away. The operator smooths the hair along the course of the vein, and makes sufficient pressure on the vein below the point of the intended wound to arrest the flow of the blood, and make the vein rise distinctly into view, but not enough to give it a thoroughly swelled and rounded surface. He places the phleme in a line with the course of the vein, with the star close to the vein and directly over its centre; he strikes the phleme smartly but not very strongly with a piece of wood called the blood-stick; and should he unhappily miss his mark or fail to make a fair incision, he repeats the stroke, taking care to place the star of the phleme in the external opening, and in such a direction as to be exactly on the centre of the vein. The pressure upon the part of the vein below the wound must be continued till a sufficient quantity of blood is taken; for on the pressure being removed, the blood will cease to flow. The blood ought to be received into a vessel of known dimensions, or, what is better, into a graduated vessel containing marks for every half pint of its capacity, so that the operator may readily observe at any moment the quantity of blood which has been abstracted. The operator ought also to make the blood fall in a regular stream into the centre of the vessel, and not allow it to trickle down the sides, so that it may regularly undergo the changes which indicate the degree of existing inflammation, and the proper time to stop the bleeding; yet he ought to base the chief weight of his opinion on the state of the pulse, and on the collective symptoms.

"The blood," says White, "should always be preserved, that the quantity drawn may be accurately known, and that its quality may be ascertained. If, after it has coagulated, a white or rather a

light buff-coloured jelly is found on the surface, an inflammatory state of the body is indicated; but in order to render this criterion useful, the blood must not be taken from too small an orifice, nor should it be suffered to run down the sides of the vessel which receives it. Blood drawn from a healthy horse very soon coagulates, and appears like an uniformly red jelly with a small quantity of fluid, resembling jelly, floating on its surface. This red jelly may, by washing, be rendered of a light buff colour, and exactly resembles the buff or size, as it is termed, of inflamed blood. The most healthy blood, therefore, contains this size, and the cause of its not being conspicuous in such blood is, that coagulation takes place before the red colouring matter can have time to separate from it. But as blood that is drawn from an animal labouring under general inflammation or fever always preserves its fluidity much longer than healthy blood, and as the red colouring particles are specifically heavier than the fluid with which they are mixed, they will of course be gradually subsiding as long as the mass continues fluid, leaving a coat of buff-coloured jelly on the surface." "Should a whitish or light buff-coloured jelly appear on the surface of the blood, after it has coagulated or settled, and should this jelly be of considerable thickness, rather firm, not easily penetrated by the finger, we may be satisfied that the horse's complaint is inflammatory, that bleeding was a proper remedy, and that, if the symptoms continue, the operation may be repeated with advantage. But if the blood coagulates quickly, is uniformly of a dark liver colour, loose, and easily broken, with a considerable quantity of water upon its surface, it denotes debility, and shows that the disease arises from a weakness of the system, and that, instead of bleeding, tonic and cordial medicines are to be employed, with every thing that may tend to restore the animal's strength."

When the flow of blood is stopped, the edges of the wound ought to be placed closely together, and made fast in that position by passing through them a small sharp pin. But in performing this operation, the skin ought not to be unduly drawn from the neck, else blood from the wound may lodge between the skin and the underlying muscles, and occasion an ugly and perhaps mischievous swelling. A little tow or a few hairs may be wrapped round the pin, so as to cover the whole face of the wound; and the horse's head ought to be made fast for two or three hours, so as to prevent him from rubbing the wounded part against the manger. If the wound be not pinned, the orifice may not close with sufficient firmness and expedition to allow the horse soon to resume labour, especially collar-work, with safety; and if the animal have liberty to depress his head below the manger, the pressure of the column of blood ascending in the neck, may occasion the rupture of the coagulum, and cause such a flow of blood as, if unobserved, may very seriously injure and per-

haps destroy the animal. Yet pinning may, in certain circumstances, be omitted without bad consequences; and in the case of dogs and black cattle, it is very seldom practised.

The operation of bleeding a horse sometimes induces a disease almost if not quite as bad as that which it is intended to cure. The wound becomes the seat of swelling and suppuration; and the cut vein becomes inflamed and is eventually obliterated. The most frequent cause of this disastrous issue is the improper closing up and subsequent treatment of the wound. If the edges of the wound are pinned ajar, a slight suppuration may be occasioned by the contortion; and if the tow be so firmly wrapped round the pin that the pus cannot escape, inflammation first spreads upon the cellular membrane around the wound, and then upon the vein itself; yet the progress of the inflammation may be arrested before the vein is attacked, by removing the pin, washing away the pus and the coagulated blood, and bathing the part with hot water or with a proper solution of sugar of lead three or four times a day, and applying a poultice at night.—Again, if the pin be inserted unduly far from the edge of the orifice, the portion of the skin outside of it, becoming dead and detached as a dry scab, is so large an obstruction to the circulation, that, before its detachment can take place, suppuration is provoked, and occasions inflammation to attack the membranes and eventually the vein.—Farther, if the pin be passed through a large portion of one side of the wound, and scarcely if at all through the other, the parts are not brought into contact, and mischievous irritation is excited.—Moreover, if the pin be inserted too near either end of the orifice, and a single hair or any other minute foreign body be enclosed, or even a portion of the coagulated blood be allowed to remain, the same kind of disastrous effects may follow. Much depends also on the situation of the part in which the incision is made; for if the vein be opened lower than six inches down the neck from the point where it divides into three branches, and if the animal operated upon be a draught horse, the retardation of the circulation of blood in the vein by the pressure of the collar, may cause the internal opening to break, and occasion such an escape of blood beneath the integuments as will irritate and inflame the cellular membrane and eventually the vein. A horse, too, who has been accustomed to be reined up in harness, and who, after being bled, is sent to grass, will so hang his head in obtaining his food, as to retard the progress of the blood to the heart, and to make the weight of it press against the sides of the vein which was wounded, and which is not yet sufficiently healed; so that the orifice is ruptured, a portion of blood escapes beneath the skin, and swelling and inflammation are produced. External irritation, also, such as friction from the rein of the bridle, or abrasion by the animal rubbing his neck against a post.

sometimes produces the same effects. Other causes, though of less frequent occurrence, are bluntness and rustiness in the phlebe or lancet, the adhesion of particles of dust to the inner edges of the wound, the hacking repetition of the incision before the blood is made to flow, the re-opening of the wound after an interval of some hours for the taking away of more blood, and the accidental destruction, in any manner, of the coagulable lymph which holds the edges of the wounds together during the early period of the process of healing. These several and diversified causes of inflamed vein, show the dangers which attend the operation of bleeding, and suggest the precautions with which that operation ought to be performed; but the disease which they produce is so distinct and serious, as to be a proper subject for separate discussion. See the article **INFLAMED VEIN**.

The bleeding of neat cattle is a strictly similar operation to that of the bleeding of horses; yet may require one or two particular remarks. A rope or strap is usually passed round the neck, and made pretty tight, in order to raise the vein; but this occasionally produces alarming symptoms, and ought to be dispensed with by every regular practitioner. The pressure of the finger, as in the case of the horse, ought to be quite sufficient for raising the vein. The lancet is the instrument most suitable to be employed; and it ought to be broader-shouldered than the lancet used for the horse. Yet when a mere rustic or the farmer himself, and not a skilful practitioner, performs the operation, he ought to use the old phlebe and bloodstick. Inflamed vein is sometimes occasioned in as bad a form in the ox as in the horse; and it ought to be guarded against by similar precautions; and, when produced, must be cured or alleviated by similar remedies.

When a sheep is about to be bled from the jugular vein, he is held between the limbs of the operator, with his croup against a wall. The operator, with his left hand, presses upon the vein a little below the spot where he intends to cut it; and, with his right hand, makes an oblique incision in the vein, at the spot where it is largest, and can be most distinctly felt through the skin. The obliquity of the incision secures a better flow of blood, than a cut either along the vein or across it. But when bleeding from the jugular vein is undesirable, a large vein which passes from the foot along the back part of the leg to the ham, and then goes obliquely over to the fore part of the limb, may be selected; and this vein is nearest the surface and sufficiently large for the operation, at a spot a little above the knee. The operation in this case is best performed by securing the other three feet of the animal, grasping the limb above the place where the vein is to be opened, causing it to swell to a state of sufficient development, and making an oblique incision in it similar to what we have

recommended in the case of the jugular vein.-- A diseased or ruptured bleeding, as from the navel or from wounds, will form the topic of a separate notice. See the article **HÆMORRHAGE**.—*Gibson on the Diseases of Horses*.—*Mackenzie on the Diseases of Sheep*.—*Papers of Mr. Dick in Quarterly Journal of Agriculture*.—*Clater's Cattle-Doctor*.—*Youatt on Cattle*.—*Youatt on the Horse*.—*Spooner on Sheep*.—*White's Veterinary*.

BLEMISH. Any feature of a plant or an animal which mars its beauty or deteriorates its value, without seriously injuring its utility.

BLETIA. A genus of interesting, exotic, hot-house plants, of the orchis tribe. About 15 or 16 species have been introduced to Great Britain, principally from the West Indies, China, and the extreme south of North America; and three of these species are herbaceous, and all the others tuberous-rooted. — Tankerville's species, *Bletia Tankervillei*, is a splendid plant, and has become a great favourite with the higher order of gardeners. It was introduced from China in 1778, attains a height of about two feet, and carries a whitish brown flower in March and April. Mr. Otto, the inspector of the Berlin Botanic garden, regarded this plant as an epiphyte, and made experimental observations on its culture; and he recommends it to be grown in plunged pots, filled with equal parts of river sand, peat earth, and leaf mould, and very sparingly watered while the roots are not in a growing state.—The modest species, *Bletia verecunda*, was introduced from the West Indies in 1733, and was known for a considerable time as a bastard hellebore, under the name of *Limodorum altum*. It grows to the height of three feet, and produces a purple flower from January till May.—The hyacinthine species, *Bletia hyacinthina*, is a great beauty, introduced about 40 years ago from China. It grows to the height of about one foot, and carries a purple flower from March till June. It withstood the frost in the open air, in the Botanic garden of Bury St. Edmunds, during the winter of 1830-31, without any other protection than such as was afforded by its position at the base of an east wall. The florid, the headed, the pallid, and the spreading-flowered species are also very beautiful, and all the other introduced species are ornamental.

BLIGHT, or **BLAST**. Any disease which seriously damages or totally prevents the fructification of a crop. It was long a subject of bewilderment and apprehension to both farmers and gardeners; and is still talked of by many cultivators in a looseness of phraseology wretchedly out of keeping with the enlightenment of the nineteenth century. It was regarded by the ancient Greeks as a blast from the offended deities, quite supernatural in its origin, and altogether irremediable in its influence; it was known among the ancient Romans under the name of *rubigo*, and supposed to be a scourge in the hand of a particular deity, whom they called *Rubigus*; and it was ascribed,

by writers on agriculture and gardening of almost all ages preceding the present, to causes which were either conflicting, mystical, or at best altogether misunderstood. Some of the most familiar and devastating kinds of it, have at length been fully investigated, and are known to be caused by insects, by fungi, or by well-defined chemical or meteorological agencies, and have been described with an accuracy and a minuteness which enable us readily to distinguish them from one another, to designate them by distinctive names, and to point out at once their origin, their indications, and their prevention, alleviation, or cure. See the articles MILDEW, SMUT, RUST, APHIS, FUNGUS, HONEY-DEW, GANGRENE, CONTORTION, CONSUMPTION, SUFFOCATION, *Æcidium*, and some others. Yet one or two kinds of blight which are still mentioned by most writers under the name of blight, and which are either principally or wholly ascribable to meteorological influence, may here be noticed.

One kind of blight is occasioned by prematurely mild weather, followed by sharp frosts and easterly winds, in spring. The very early appearance of buds and blossoms excites delight in the inexperienced, but apprehension in the judicious; for subsequent frosts and east winds may very probably arrest the flow of sap from the roots, occasion the young leaves and shoots to shrivel and die, and cause the arrested juices to swell and burst the tender vessels, and to become the prey of innumerable aphides. The general result is either the death of the plant, the destruction of its growth for the season, or at the least the infliction upon it of a great degree of temporary feebleness. The aphides which feed upon the extravasated juices, though but a consequence of the blight, are sometimes mistakenly regarded as the cause of it, and supposed to be wafted by the east wind. Unskilful gardeners occasionally aggravate the blight by their very solicitude to avert it, closely matting up its trees or keeping them protected during the day, so as to render them so exceedingly tender that even a slight subsequent frost does them material damage. The sudden evaporation of hoar-frost from the opening leaflets of a young hedge, by a powerful sun, in a calm vernal atmosphere, sometimes so utterly destroys the incipient shoots and kills all the young foliage as to produce, in a few days, the appearance of a severe scorching by fire. A hedge thus blighted, occasionally remains leafless throughout the summer, or only shows some feeble symptoms of exfoliation toward the beginning of autumn; and it ought, in every case, to be left untouched till, by its own vitality or without any artificial appliance, it has recovered strength and vigour.

Another kind of blight occurs in summer, when farm crops have attained their full growth, and is usually ascribed to sultry and pestilential vapour. This blight formerly made great havoc upon the vineyards of Italy, and still partially

scathes some of our potato crops, and scorches and shrivels considerable portions of our crops of hops and wheat. The Romans observed that it generally occurred at the season of the ripening of grapes, about noon, after short and heavy showers, followed by sunshine, and that it made the greatest devastation in the centre of vineyards; and the English hop-growers of the present day observe that it occurs most frequently about the end of July, after rain followed by hot sunshine, and that, whether general or partial, it usually begins in the centre of the hop-ground, and inflicts there its largest proportion of injury. In one instance which was minutely observed, the blight happened a little before noon, during a very light or little more than perceptible wind, and ran in the direction of the wind and at right angles with the direction of the sunbeams. See the article FIRE-BLAST. A marked instance of this summer blight in wheat, is recorded in the following terms by a close observer. "In the summer of 1809, I had watched the progress of the growth of a field of wheat on rather a light and sandy soil, merely from having had occasion to pass through it every Sunday in going to serve a church. It came up with every appearance of health, and also into ear, with a fair prospect of ripening well. I had taken particular notice of it on a Sunday about the beginning of July, as exceeding anything I could have expected on such a soil. But on the following Sunday, I was surprised to find a portion of the crop, on the east side of the field, to the extent of several acres, totally destroyed,—being shrunk and shrivelled up to less than one half the size of what it had formerly been, with an appearance so withered and blasted that I for some time imagined I had got into the wrong field. The rest of the field produced a fair crop." But though such instances as this are ascribed wholly to atmospherical causes, a careful inspection of the straw might possibly detect the presence of minute parasitic fungi.

A third kind of blight, popularly called in England the white blight, is occasioned by deficiency or failure of proper nourishment; it occasionally attacks all kinds of plants, both wild and cultivated; it is, as might be expected, most common in thin gravelly irretentive soils, in very dry seasons; and it usually consists in throwing the plants prematurely into blossom, and ripening the ear or pod before the body or more than the mere embryo of the seed is formed.—The only known palliatives or preventatives of these three kinds of blight are proper condition and thorough culture of the soil.

BLIGHT-BUG. See APHIS.

BLINDNESS. The want or deprivation of sight. Blindness occurs frequently in horses, and very greatly deteriorates their value,—rendering them useless for some kinds of work, and only half useful for others. The causes of it are too obscure or recondite to be detected before

they produce their effect, or to be even conjecturally counteracted by any other means than the general good treatment of the animals. Two common but quite incurable kinds of blindness are noticed in the articles AMAUROSIS and MOON-BLINDNESS; and a third kind is occasioned by ophthalmic inflammation. The blindness of a horse, when induced, may be known by the uncertain, unequal, and hesitating manner of his gait, by his occasionally lifting the foot as if to step over an obstacle when no obstacle exists, by his pricking up his ears and moving them in a peculiarly listful manner when any person enters the stable, by his hanging back timidly and hesitatingly in his halter, and especially by the dilatation or contraction of the pupil of the eye under sudden transitions from light to darkness, or from darkness to light. See the article EYE. But when a blind horse is mounted by an expert horseman, he may show none of the symptoms in hesitation of gait, but, under the action of the spurs, and from adroit management, may move with perfect resolution and freedom. A horse blind in but one eye may, according to circumstances, either be very little or very much deteriorated. "The loss of one eye," says Mr. Percivall, "does not enfeeble sight; because the other acquires greater energy, though it much contracts the field of vision. It is said to render the conception erring; and the case of misjudgment of distances is the one commonly brought forward to show this. All I can say on this point is, that the best hunter I ever possessed, a horse gifted with extraordinary powers for leaping, was a one-eyed horse; and this animal carried me through a hunting season, without, to my recollection, making one single blunder in leaping." But, says Mr. Youatt, "although a one-eyed horse may not be absolutely condemned for the common business of the carriage or the road, he is generally deteriorated as a hunter, for he cannot measure his distances, and will run into his leaps. Many a sportsman, puzzled and angry at the sudden blundering of his horse, or injured by one or more stunning falls, has found a very natural although unexpected explanation of it in the blindness of one eye, and that perhaps produced through his own fault, by over-riding his willing and excellent servant, and causing a determination of blood to the eye, which proved fatal to the delicate texture of the retina. Even for the carriage or the road, he is considerably deteriorated; for his field of observation must be materially lessened."

Blindness is much more frequent, but far less inveterate, among sheep than among horses. If almost any flock of sheep be carefully examined, the eyes of one half of them will either show symptoms of partial or total blindness, or present indications of quite recent recovery from blinding disease. The most common causes are prolonged fatigue, hard driving, chasing about by dogs, burying beneath the snow, warm days followed

by frosty nights in winter, and, as some think, the blowing of the pollen of flowers into the eyes, and sometimes either infection or some undefined description of epidemic influence. In some kinds of blindness, the whole surface of the eyeballs has a light blue colour, resembling the colour of deep salt water when seen perpendicularly in clear sunshine; but in the more common kinds, a white film gradually spreads over it till the whole surface assumes a pearly whiteness. All the kinds, however, appear to be preceded or accompanied by inflammation; and when properly treated, or even sometimes when they are merely let alone, they, with few exceptions, gradually and speedily disappear. The principal remedy, in all bad cases, is to bleed the vein under the inner angle of the eye, on the side of the nose. The operator either takes the sheep between his knees, placing its rump against a wall, or lays it on its back, to be held in that posture by assistants; he next, with his left hand, presses the vein about two inches from the angle of the jaw, and opposite the third grinder; and, immediately upon the vein becoming sufficiently full, he punctures it at a spot about an inch from the eye. All stimulating applications, such as a solution of white vitriol and other kinds of common "eye-water," ought to be carefully avoided; for they will only increase the inflammation, and augment the risk of permanent blindness. Almost the only wash which can be of service is either a drop or two of vinous tincture of opium introduced to the eye, or a lotion consisting of a teaspoonful of common tincture of opium and half a pint of water freely applied to the exterior. Incurably blind sheep incur some risk of drowning in ponds or of other fatal accidents, and, on that account, may at once be sent to the butcher; yet, after a few days of awkwardness and confusion, they are almost certain to become perfectly accustomed to the paths of the pastures, and to be taken under the voluntary and constant guidance of some other sheep of the flock.

Blindness not unfrequently attacks poultry, and may, in general, be easily cured. It is generally a consequence or an accompaniment of roup, and disappears when that disease is cured. It is sometimes the result of pure inflammation of the eye, and may consist in either cloudiness, ulceration or enlargement of that organ, and may be cured by a few fomentations with warm water, each followed by the introduction of a few drops of very diluted laudanum between the eyelids. It is sometimes also the effect or symptom of some other disease, and consists in the closing up of the eye with mucous matter; and in this case, it may be removed by such simple means as the cleaning of the coup, and a slight protection in any manner from cold winds and chilly air.—*Transactions of the Highland Society.*—Percivall on the Veterinary Art.—Youatt on the Horse.—Clater's Cattle Doctor.—Gibson on the Diseases of Horses.

BLINDWORM. A species of *anguis* or snake, —the *Anguis fragilis* of Linnæus, and probably the *A. eryx* of Pennant. It is sometimes designated the *slow-worm*, or the *deaf adder*. The common blindworm is described as being greyish-brown above, bluish-black beneath, with several parallel rows of small dark spots along the back, and a dusky band on each side; and the variety, or supposed species, named *Eryx*, is said by Pennant to have the belly of a bluish lead-colour, marked with small white spots irregularly disposed; the rest of the body greyish-brown; with three longitudinal dusky lines, one extending from the head along the back to the point of the tail, the others broader, and extending the whole length of the sides. Mr. Ryland says: "Such variations cannot be considered as specific. Sometimes the slow-worm has the upper parts without lines at all, sometimes with a single line, and sometimes with seven lines; the lower parts either uniformly bluish-black, or with a broad band of the same colour as the back, and on each side a central dark band. The number of lines is, I think, fourteen on each side, twenty-eight in all, that being the number of series of scales. Some specimens are destitute of white spots on the lower part of the abdomen and tail, but in most individuals they are more or less apparent. Young, or at least small individuals, generally have the lines more distinct." Mr. Ryland continues: "I am led to suppose, from Mr. Salmon's remarks, that a prejudice against these inoffensive reptiles exists in his neighbourhood, similar to the belief prevalent in Lancashire. The notion of the lower orders here respecting this snake is curious, and will be best shown by a conversation I once had with a turf-cutter:—'Well, my man, you have other kinds of snakes here (Woolston Moss) besides the viper?' 'Ay, Sir, we sometimes light on blindworms and edders.' 'Indeed!' 'Ay: but the blindworms are the worst, and desperate hard to kill. Whoy, if you were to cut one into half a dozen pieces, they 'ud join again!' A medical friend informs me that a belief in the power of separated parts of this snake reuniting is prevalent amongst the lower classes in Scotland. How can it have originated?" In Scotland, the lower classes imagine the blindworm to be as poisonous as the viper or adder, and generally do not distinguish the one species from the other. Knowing that serpents have often bitten, or, as they think, stung persons, as well as cattle, and as they are thus dangerous, they naturally on falling in with one kill it, and to make sure work, usually cut it into pieces with a knife, it being a prevalent belief among them, that a serpent, if merely bruised, will or may come alive again. Their abhorrence of the animal, and their apprehension of the possibility of reviving, even leads them to separate the pieces to a distance; but the belief of a reunion of the parts, if left in proximity, is merely the result of fear carried to ex-

cess. The blindworm is a very harmless creature, but, like many other innocuous snakes, participates in the bad character of those which are venomous. A very slight blow with a stick is sufficient to disrupt this animal, and individuals are often seen with part of the tail wanting, in which respect it resembles the lizards.

BLINKERS. Leather plates permanently attached to the sides of a bridle, and so adjusted as to prevent a horse from seeing objects on either side, without obstructing his vision in front.

BLISTER. A medicinal preparation for inflaming the skin, and producing vesicles filled with a watery or serous liquid. It is one of the most effective appliances of the healing art, and constitutes the chief remedy in the case of a considerable number of diseases. The main principle on which it acts is that of counter-irritation, or of reducing inflammatory action in an interior organ of the animal system by exciting a stronger local inflammation on the nearest exterior part of the system; and a subordinate principle is the accelerating of the action of the nearest vessels, or the rousing of the local absorbents to a temporary condition of unusual energy.

Blisters are eminently efficacious in dispersing such callous swellings as arise from strains, bruises, and other similar causes. They are of great service in reducing the inflammation of parts remote from the surface: thus inflammation of the internal parts of the foot is reduced by blistering the pastern; inflammation of the bowels, by blistering the abdomen; and inflammation of the lungs, by blistering the sides. Blisters are also the best remedies for curbs, windgalls, spavins, and various other disorders. When properly made and free from any such caustic ingredients as sulphuric acid and corrosive sublimate, they inflict no permanent damage on the skin, and do not prevent the hair from growing; and when they are not successful in the first application, they can with all safety be repeated. But a blister ought never to be applied to a part which is irritated or tender, for it might then produce extensive and virulent ulcer; nor ought it ever to be applied where there is a tendency to grease, for it will probably aggravate the disorder; and whenever it requires to be applied during winter, thorough care ought to be used to protect the animal from cold or from a current of air about the legs.

When a blister is to be applied, the part should previously be cleared as much as possible from hair, a quantity of the blistering ointment should be well rubbed into it, and a thin coat of the ointment afterwards spread over it with a moderately warm knife. A horse on beginning to feel the action of the blister, is very apt to bite the part, and, in consequence, both to do serious mischief to the part and to blister his mouth; and to prevent this, he ought either to be tied up to the rack, or to have what is called a cradle

placed about his neck. When a blister is applied to any of the legs, the litter must be completely swept away in order to prevent irritation of the blistered part by straws.

The most active ingredient in the great majority of suitable blisters, is pulverized Spanish flies. One common blistering ointment for horses is compounded of half an ounce of pulverized Spanish flies, an ounce of oil of turpentine, and four ounces of hog's lard or simple wax ointment; another is compounded of an ounce of pulverized Spanish flies, an ounce of oil of turpentine, two drachms of sulphuric acid, and four ounces of hog's lard; and a third is compounded of $1\frac{1}{2}$ or two ounces of pulverized Spanish flies, half an ounce of oil of origanum, two drachms of sulphuric acid, two ounces of hog's lard, and four ounces of common tar. The last of these is said to be peculiarly suitable for removing enlargements of the back sinews or windgalls. Sulphuric acid ought to be omitted in every case in which a somewhat caustic influence is undesirable. Corrosive sublimate has frequently been recommended as an ingredient; yet, except when very severe blistering, as in a case of bone spavin, is required, it ought in every instance to be omitted, for it is very apt to ulcerate the skin, and it leaves a permanent mark or blemish. Good mustard, made into a paste with hot water, and applied hot, often blisters as well as Spanish flies' ointment; and ought to be used in inflammation of the kidneys, and in any other case in which a mischievous operation of Spanish flies is to be apprehended. Tincture of croton, and some of the preparations of iodine, also make active blisters.

BLITE, or **STRAWBERRY BLITE**,—botanically *Blitum*. A genus of hardy annual plants, of the goosefoot tribe. Two ornamental species, the berry-headed and the twiggy, were introduced to Great Britain from the warmer parts of Continental Europe, in the course of the 17th century, and have ever since been regarded with considerable favour. Both grow to the height of about two feet, and bear apetalous flowers from May till August. The flowers of the berry-headed species are produced in small heads from the several joints of the stem, and in a cluster from the top; and after the flowers have ceased to bloom, the little heads swell to the size of wood strawberries, assume a similar appearance to these fruits, and become filled with a purple juice which gives a deep purple coloured stain to the hands of persons who bruise them. Two other species, the goosefoot-like and the petiolate, possess no interest; but a curious species, the maritime or sea-side, was introduced a few years ago from North America.—An uninteresting species of amaranth, with green flowers, of annual growth and trailing habit, frequently found on the dung-hills of England, bears the name of wild blite,—*Amaranthus blitum*.

BLOCKS. Pieces of wood in which sheaves or

pulleys are placed, for the purpose of forming tackle, purchases, &c., in various operations in naval tactics and architectural constructions. The mechanical power is described in the article **PULLEY**. Blocks are single, double, treble, and fourfold, according as the number of sheaves is one, two, three, or four. The sheaves are grooved to receive the rope, and have in their centre a brass *bush*, or triangular piece of brass, to receive the *pin* on which they revolve. The sides of the block are called *cheeks*. A *running* block is attached to the object to be moved; a *standing* block is fixed to some permanent support. Blocks also receive different denominations from their shape, purpose, and mode of application, which cannot be well explained without the use of figures. No less than 200 different sorts and sizes are made at Portsmouth, England, for the royal navy, besides which there are various sorts used only in the merchant-ships. The machinery for supplying the royal navy with blocks is the invention of Mr. Brunel, an American artist. It enables 4 men, in a given time, to complete the shells of as many blocks as 50 men could do by the old method.

BLOOD. The red fluid contained in the blood-vessels of animal bodies. It is found in the mammalia, in birds, in reptiles, and in fishes. In the last two classes of animals, the temperature of the blood is much lower than in the former, for which reason they are distinguished by the name *cold-blooded*, while the others are termed *warm-blooded* animals. Insects and worms, instead of red blood, have a juice of a whitish colour, which is called *white blood*. In the blood, two different substances are contained, which are separated by coagulation,—the *serum*, a fluid like the white of an egg, and a thick matter, to which the red colour properly belongs, which is much heavier than the former, and is called the *coagulum*. The last may be divided again into two different parts,—into the *cruor*, or that part of the blood which is intrinsically red, and coagulable, and *lymph* or *fibrine*, to which the coagulation of the blood must be ascribed. The *fibrine*, in young animals, is much whiter than in older and stronger ones. The blood of the latter contains much more azote than that of the former. If the nourishment of animals is changed, we also find an alteration in the constituent parts of their blood. It is also changed by diseases. In animals that are hunted to death, or killed by lightning, the blood does not coagulate. The blood of birds is more highly coloured, and warmer, than that of viviparous animals, and coagulates more easily in the air. That of reptiles and fishes coagulates with difficulty. Aided by magnifying glasses of a strong power, one may observe, in examining the blood of the living animal, or in blood which is newly drawn, that it consists, especially the *cruor*, of little globular bubbles, the *globules* of the blood, as they are called, the diameter of which amounts to about the three hundredth

part of a line. In blood that has been drawn some time, although this time may be very short, they are not to be discovered. They are the effect of the life that pervades the blood. The more robust and healthy an animal is, the more globules are perceived. They show, as it were, the transition from the formless liquid to the original form of the first organized matter. The blood is of the greatest importance to the life of an animal, and may be considered as the source of life. As long as the body is living, the blood is in perpetual motion. When it is taken out of the body, a remarkable change soon follows: it begins to coagulate, and then undergoes, first an acetous, and, after a few days, a putrid fermentation. All the blood takes its origin from the chyle, and deposits, by degrees, the nourishing particles requisite to the preservation and growth of the body, by a multitude of vessels adapted thereto. This is done while it is driven from the heart into the remotest parts of the body, and from thence back. The circulation of the blood is, as it were, the principle and first condition of life. With it, except in cases of fainting, suffocation, &c., life ceases. The heart, the centre of the circulation of the blood, has a two-fold motion of contraction and dilatation, which constantly alternate. With the heart two kinds of vessels are connected,—the arteries and the veins. The circulation of the blood proceeds with an astonishing rapidity: did it flow at an equal rate in a straight line, it would run, in the space of one minute, through 149 feet. This swiftness, however, exists only in the larger vessels near the heart; the farther the blood recedes from the heart, the slower its motion becomes. In a grown-up person, in good health, we may reckon the mass of blood at 24 to 30 lbs.

BLOODFLOWER,—botanically *Hæmanthus*. A genus of tender, beautiful, bulbous-rooted plants, of the amaryllis tribe. About twenty species have been introduced to Great Britain,—one from Sierra Leone, and all the others from the Cape of Good Hope. One of the species, the scarlet, was introduced in 1629; twelve in the course of the last century; and the others, since 1800. The stems of most rise to the height of about a foot; and those of the remainder to about six or nine inches. Three, the white-flowered, the orbicular, and the pubescent, have white flowers; and the others have flowers of various shades of red, from scarlet and crimson to pink and flesh-colour. All are propagated by offsets, and grow well in sandy loam mixed with a little peat. The leaves of several of the species are large, fleshy, and peculiarly shaped, and have a very remarkable and interesting appearance during winter. Miller describes two of the three species known in his day as difficult of propagation in Europe; and one of these two as exceedingly shy in coming to flower.

BLOOD-HORSE. See HORSE.

BLOODHOUND. A variety of the dog, for-

merly much used and highly prized, on account of its exquisite scent and extraordinary perseverance, for tracking and seizing depredators and other obnoxious persons. A British bloodhound of pure blood is now comparatively rare, and, excepting in a few instances, for the seizing of sheep stealers, is kept only as an object of ornament and curiosity. He is compact, muscular, and strong; his height is about 28 inches; his prevailing colour is a reddish tan, gradually darkening from the sides to the back, and there becoming blackish; his forehead is broad; his face toward the muzzle is narrow; his nostrils are wide and fully developed; his ears are large and pendulous; his tail is long; his aspect is sagacious and calm; and his voice is deep, sonorous, and powerful. Previous to the union of the English and the Scottish crowns, great numbers of bloodhounds were kept by the warrior population of the borders, and employed in feuds against moss-troopers and even against princes; and, under the name of sleuth-hounds, they mingle in the romantic story of Bruce, of Wallace, and of many a border chieftain. The bloodhound of Cuba closely resembles the old British bloodhound in habits and instinct, but very considerably differs from him in shape. This animal is still employed by the Cubans to pursue felons and murderers; and possesses an appalling notoriety in history as a principal auxiliary of the Spaniards in their atrocious conquest of America, and of the West Indian colonists in their inhuman warfare with the revolted Maroons of Jamaica. A writer in one of the Dublin Medical journals says: "There are three dogs at present known under the name of bloodhound, which, though by some considered distinct from one another, I am disposed to regard as varieties of the same animal, the difference in their appearance being probably owing to climate, if not, indeed, to some intentional or accidental cross. These varieties are the African, the Cuban or Spanish, and the British. The first, viz. the African, I am inclined to regard as the original whence the others sprang. The Cuban seems to have a dash of the greyhound in him; and the British would appear to have been improved by the intermixture of the old English Talbot, which I take to be a far more genuine as well as more ancient animal. The African bloodhound is very seldom to be seen in this country. He sometimes resembles a very large and raw-boned Spanish pointer. His ears are pendulous and fine in texture, about the length of a foxhound's; coat very fine, and skin apparently thin; colour generally dark liver-colour clouded with black, yet sometimes tan; muzzle nearly always black, as also the tip of his ears; head pretty large, and shaped like a pointer's; eyes placed towards the front; tail fine, and carried rather horizontally than erect. The appearance and manners of this dog are ferocious in the extreme; he stands about twenty-six inches high at the shoulder, often less, but seldom more. I saw one

of these animals in London some time ago, which had been brought from the Cape of Good Hope, and from him took my description; he was the only African bloodhound I have ever seen; and as these dogs are apt to die when brought to a cold climate, I dare say few of my readers (if any) have ever met with one of them. Two African bloodhounds were brought to England, and presented to the Tower menagerie, by Major Denham. A drawing of them may be seen in the first volume of a very interesting work published by the Society for Promoting Entertaining Knowledge,—entitled 'The Menageries.' I was also shown a sketch of one, and furnished with a description similar to the one I have given above, by a friend who had spent some time at the Cape. These are very swift dogs, of exquisite sense and smell, great endurance, and indomitable courage. My account of the African variety ends here, and I now come to one somewhat better known—one, at all events, concerning which information is more easily obtained—viz., the Cuban or Spanish. This animal does not differ so greatly in form from the former-described variety as at first sight might be supposed. It is in general much taller, is of a slighter make, bears its head higher, and is altogether a more imposing-looking dog than the preceding. It is said to be inferior in smell, which I conceive must be the case from the formation of the head and nose; but what it wants in scent it makes up in speed, being in this respect little inferior to many greyhounds. This dog is to be found in greatest perfection at present in South America; many are brought from the West Indian islands also, but are scarcer there than on the continent. This is a very tall dog, being frequently twenty-seven to twenty-eight inches high at the shoulder: in his general shape he resembles a smooth lurcher, or a cross between a greyhound and a mastiff; his head is thick across the temples; muzzle long and rather fine, yet by no means so small as a greyhound's; ears something like a greyhound's, but larger and much more pendulous. This dog's neck is long, and as he carries his head well up, he has, when a good-sized specimen, a very noble appearance; his tail is moderately long, and tapers to the extremity; it is very slightly villous beneath; colour generally tan shaded with black above—sometimes liver-colour—and occasionally mouse-coloured or silvery-grey; the muzzle and tips of his ears are generally darker than the rest of his body—often black. This dog, be it observed,—and I state this on the authority of a native of South America,—is never seen mottled or of two colours; that is to say, speckled or streaked, or black and white, &c. When such is the case, rest assured that the dog is not by any means well-bred, but has probably had for one of his parents a boar-hound or Danish dog. The eyes of this dog are placed very much towards the front of the head, and very close together, which I conceive must tend in some measure to confine

his vision to objects more immediately in front. This is the well-known dog rendered so famous, or rather infamous, from his having been employed by the Spaniards in their cruel and exterminating conflicts with the Americans; the same, also, since frequently used in the capture of runaway slaves in the West Indies. I have been informed that on such occasions a small dog of the spaniel breed should be used, called a finder, as the bloodhound is slow at hitting off the trail unless so aided, not possessing the same nicety of smell that is displayed by the two other varieties. He is a dog of extreme courage; is capable of much affection; seldom exhibits treachery unless to entrap a declared foe or a strange beggar-man, on which occasions he has been known to simulate sleep, and thus induce the unsuspecting man to pass within reach, on whom he would certainly spring were he so unwary. Their manner of seizing and biting closely resembles the practice of the bull-dog, (*C. molossus*.) They never let go their hold when they have once fastened, but increase their mouthful continually, making every effort to tear away the bit, which they not unfrequently do. Let them once fasten on the throat of their foe, and, whether uppermost or undermost, the battle is their own. One of these dogs killed a good-sized bull-dog in about ten minutes, never having changed the hold he got at first. I saw one of these dogs opposed to a bear, on which occasion he did very well, but Bruin having ripped the skin off his shoulder, he declined further combat, and resigned the field of battle in favour of a young boar-hound, son of his Grace the Duke of Buccleugh's dog 'Hector,' which, though barely eighteen months old, pinned the shaggy monster by the nose, hurled him to the ground, and punished the poor bear so severely, that in a few minutes the brute howled for quarter, and was glad to yield, 'rescue or no rescue.' I feel it my duty to remark, '*en parenthèse*,' before going any farther, that although I may thus mention '*combats des animaux*,' or even minutely describe them, yet I condemn them *in toto*,—as cruel and degrading to human nature. I saw many such scenes when a much younger man than I am now. My blood was warmer than it is at present, and in the excitement of the scenes I witnessed, I forgot for a long while to reflect upon their barbarity. When I mention such things, therefore, it is merely to display the character of the animal I am describing in a clear point of view, while at the same time I disapprove of such practices. The Spanish bloodhound is more commonly seen in this country than the African or British varieties, and I have found that to it is the name of bloodhound almost exclusively applied. The finest specimen of the breed I have ever seen was in the possession of Mr. Johnston of Edinburgh, to whom, as I was told, it had been sent from Jamaica by a brother resident there. I was informed that Mr. Johnston was

offered sixty guineas for this dog, which, however, he refused. I saw this animal, in company with a young South American, who assured me of its being, as far as he could judge, a perfectly fine specimen. I saw also a smaller dog of the same breed in Edinburgh, in the possession of Mr. Charles MacKnight, son of the late Dr. MacKnight of that city. At that time I did not believe Mr. MacKnight's dog to be thoroughbred, in consequence of its diminutive size. I have since, however, seen one in Dublin, the property of Sir Philip Crampton, the surgeon-general, which is even less than it, and of the purity of whose blood I can hardly entertain a doubt. The surgeon-general's dog is of a very light mouse or silvery-grey colour, and appears certainly far better bred than any of her offspring I have ever seen. I also saw two of this breed in London; they had been brought from Barbadoes, and were handsome animals."

BLOODSHOT EYE. The inflamed eye of an animal. A proper remedy is bathing with anodyne or cooling lotions,—for example, cold spring water, either by itself, or with a slight admixture of laudanum.

BLOOD-SPAVIN. A dilatation of the vein which runs along the inside of the horse's hock. It forms a little soft swelling in the hollow part, and frequently causes weakness or lameness of the limb. It may be bathed twice a-day with vinegar or verjuice; or it may be fomented with a decoction of oak-bark, pomegranate, and alum, basted in verjuice, and afterwards bound over with a flannel roller, soaked in the same preparation. If these remedies fail, "the skin," says Bartlet, "should be opened, and the vein tied with a crooked needle, and waxed thread passed underneath it, both above and below the swelling, and the turgid part suffered to digest away with the ligatures; for this purpose the wound may be daily dressed with turpentine, honey, and spirit of wine, incorporated together." But this method of proposed cure by ligatures is now condemned by all skilful veterinary surgeons; and the ulterior methods at present practised are the same as for bog-spavin,—blistering and firing. See the article **BOG-SPAVIN**.

BLOOD-VESSELS. The tubes or vessels in which the blood circulates. They are divided into two classes,—arteries and veins,—which have two points of union or connexion—the first in the heart, from which they both originate, and the other in the minute vessels or net-work, in which they terminate. The arteries arise from the heart, and convey the blood to all parts of the body; the veins return it to the heart. The arteries distribute throughout the body a pure, red blood, for the purposes of nourishment; while the veins return to the heart a dark-coloured blood, more or less loaded with impurities, and deprived of some of its valuable properties. But this is not returned again to the body in the same state. For the heart is wisely divided into two

portions or sides, a right and left, one of which receives the impure blood from the veins, and sends it to the lungs to be defecated and freshly supplied with oxygen or vital air, while the other receives the pure red blood from the lungs, and circulates it anew through the arteries. The arteries arise from the left ventricle of the heart, by one large trunk, nearly an inch in diameter, which is gradually subdivided into smaller ones, as it proceeds towards the limbs, till they terminate, at last, in vessels so small as to be almost invisible, and in a fine net-work of cells, extending through the whole body, in which the blood is poured out, and nutrition or the increase of the body takes place, and from which the residue is taken up by the small veins, to be returned to the heart. The arteries and veins are widely different in their structure, as well as their uses. The former are composed of very strong, firm, elastic coats or membranes, which are four in number. The external covering and the internal lining of the arteries, although belonging to different classes of membranes, are both very thin and soft. The second coat is very thick, tough, and elastic, being that which chiefly gives their peculiar appearance to the arteries. The third is formed of fibres, apparently muscular, arranged in circular rings around the tube of the vessels. It is well known that the pulse of the heart is felt in the arteries alone, although, in the bleeding of a vein, we sometimes see the blood start as if in unison with the beating of the heart. The pulse is produced by the wave or stream of blood, which is driven by the heart through the arteries, distending and slightly elevating them, after which they instantly contract from their elasticity, and thus force the blood into the smaller vessels. The pulse varies in its character with the general state of the health. When arteries are cut or wounded, the firmness of their coats prevents their closing, and hence arises the fatal nature of wounds of large vessels, which will remain open till they are tied up, or till death is produced.—The veins commence in small capillary tubes in every part of the body, and, by their gradual union, form large trunks, till they at last terminate in two (one ascending from the lower parts of the body, the other descending from the head and arms), which pour their contents into the heart. Their structure is much less firm than that of the arteries. They are very thin and soft, consisting of only two thin coats or membranes. The inner, or lining membrane, is frequently doubled into folds, forming valves, which nearly close the passage in the veins, and thus give very material support to the blood as it is moving up in them towards the heart. These valves are not found in the veins of the bowels, the lungs, or the head. The number of the veins is much greater than that of the arteries, an artery being often accompanied by two veins. They differ also in this, that, while the arteries are deeply seated in the flesh, to guard

them from injury, the veins are very frequently superficial, and covered only by the skin. The veins, it is well known, are the vessels commonly opened in blood-letting, although, in cases which render it necessary, a small artery is sometimes divided.—There are two portions of the venous system, which do not correspond exactly with our general description; these are the veins of the bowels and of the lungs. The former circulate their blood through the liver before it returns to the heart, and the latter, the pulmonary veins, convey red blood from the lungs to the heart. (For an account of the circulation of the blood, see HEART.) It should also be mentioned that the large vein, which brings back the blood from the lower part of the body, receives from the lymphatic and lacteal vessels the chyle from the bowels, which supplies the waste of the blood and nourishes the body, and the serous and other watery fluids which are taken up by the absorbents in all parts of the body.

BLOODWORT, or *Puccoon*,—botanically *Sanguinaria*. A perennial, tuberous-rooted, hardy, ornamental plant, of the poppy-tribe. The only known species is the Canadian,—*S. Canadensis*; and this was introduced to Great Britain from North America in 1680. It was at one time regarded as a celandine. Its flower somewhat resembles that of the wood anemone, but stands on a short, naked pedicle of about six inches in length, has sometimes so many as ten or twelve petals, and appears in March and April. The green leaves come out at the fading of the flowers, and continue till midsummer. A yellow juice is yielded by the whole plant, possesses narcotic and emetic properties, and is used by the American Indians for painting their persons. Bloodwort may very suitably be mixed with dog's-tooth violet, spring cyclamen, Persian iris, bulbocodium, sisyrinchium, and some other low-growing and bulbous or tuberous rooted flowering-plants, which require the same culture.—The name bloodwort is often popularly given also to the large, beautiful, indigenous, fusiform-rooted, bloody-veined dock,—*Rumex sanguineus*.

BLOODY-TWIG. See Dogwood.

BLOOM. The period of the expansion or living freshness of the flowers of herbaceous plants and of the blossoms of trees.

BLOOM. A very fine and soft powder on the leaves and fruit of certain plants, and particularly on the leaves of cabbages and the fruit of plum-trees. It is easily rubbed off; it occasions a peculiar shade of colour; it is slowly reproduced on a leaf or fruit from which it has been removed; and, when seen through a microscope, it appears to consist of unpolished granules similar to those of starch. It is insoluble in water, and, in consequence, resists dew and rain. Some scientific men regard it as a resin, and others pronounce it to be wax.

BLOSSOM. The flower of a fruit-tree. It possesses exactly the same phytological character

as the flower of any other class of plants; and takes its distinguishing name of blossom from the mere circumstance of its being the forerunner of an edible fruit. The secretions of a tree are usually most abundant immediately before the formation and during the continuance of its blossoms; the pruning of fruit trees, in consequence, occasions a great enlargement of both the blossoms and the fruit; for these parts of a pruned tree receive, in the character of an excess of nourishment, the alimentary juices which would have formed and fed the secretions of the lopped-off boughs.

BLOW-MILK. Milk which is skimmed by the method of blowing off the cream.

BLOWN. The cattle disease more commonly called hoove and hoven. See the article *HOOVE*.

BLOWPIPE. The name applied to an instrument, by means of which the flame of a candle or lamp is made to produce an intense heat, capable of being applied to a variety of useful purposes. Its most simple form is that of a tapering tube, about eight inches in length, and curved nearly at right angles, within two inches of its smaller extremity. At its larger end it is nearly a quarter of an inch in diameter, and at the smaller, only large enough to admit a common-sized pin. It is made of brass or white iron. In using it, the flame of a lamp or candle is turned aside from its vertical to a horizontal direction, by a stream of air impelled upon it, either from the lungs, or from a double bellows. The flame, in its new direction, assumes a conical shape, and consists of two parts, visible by their different colours; the outer being reddish-brown, and the inner blue. The heat at the apex of the inner cone is the most intense, and is equal to that produced in the best furnaces. It is employed by the jeweller and goldsmith in the operation of soldering, and by other artists who fabricate small objects in metal; by the glass-blower in making thermometers, barometers, and other glass instruments; by the enameller, and, indeed, wherever it is required to subject a small body to a strong heat.—The common blowpipe has undergone a variety of improvements in the hands of the chemists, to whose researches it has proved an excellent auxiliary. These consist, principally, in providing its stem with a bowl, or enlargement, where the moisture of the breath may be condensed and detained; in fitting the smaller end so as to receive a variety of little caps, or hollow cones, with orifices of different diameters, so as to be changed according as a flame is required more or less strong; and in rendering the instrument more portable, by constructing it of several pieces, capable of being taken apart and packed up in the space of a pencil-case. With a part, or with the whole of these improvements, it is used by the chemist to make an examination of any doubtful mineral substance, artificial alloy, or pharmaceutical preparation. This he is capable

of conducting (with the aid of a charcoal support, and, occasionally, a little borax) in a moment's time, and with the loss of the smallest imaginable quantity of the substance. To the analytical chemist its use is indispensable for enabling him to discover the principal ingredients in a substance, previous to his subsequent operations for ascertaining their relative proportion. For an account of the blowpipe in which oxygen and hydrogen gases are employed, see **COMPOUND-BLOWPIPE**.

BLUBBER. The portion of the fatty substance of the whale which remains after the oil has been separated by the process of boiling. It is obtained in large quantities at the several ports which have connexion with the whale fisheries; and when judiciously used, is an excellent manure. It operates by giving out large supplies of carbon and hydrogen, to combine with the oxygen of the atmosphere, and afford aliment to plants; and it exerts a prolonged influence, or is what farmers call a durable manure, in consequence of its resisting the action of water, and but slowly yielding to that of air. But, if applied in its crude state, it will destroy vegetation; and even if too largely applied as an ingredient in a compost, it will produce a disastrous effect. A good method of using it, is to mix each ton of it with about twenty tons of very fine mould, frequently to turn over the compost during a period of three or four months, and to spread it on the surface of land in autumn, and plough it in. It ought not, however, to be indiscriminately applied to any kinds of soils or at any periods of a rotation, but as nearly as possible adapted to such a position as the preparation of lea ground for oats.

The late Lord Somerville, who was one of the first agriculturists to bring it into notice as a manure, and who applied it to both the arable and the pasture lands of his farm of Fairmile in Surrey, mixed it with sandy earth and allowed it to dissolve in the heap; and he found its action to continue during two or three years, and to produce prime crops. A farmer, speaking of his own use of it during twelve years, says, "My first essay was with it in its crude state, when it destroyed instead of assisting vegetation. I have since made the blubber into a compost, in the proportion of nine loads of earth to one load of blubber. My plan is, first, to make a layer of earth two feet thick, the length and breadth in proportion to the quantity of blubber to be made into compost. This layer of earth is covered with blubber, about one foot in thickness, on which another layer is laid, and so on alternately, until the blubber is composted, covering the whole three feet with earth, close beat down at the top and sides, the same as is done to secure potatoes from the frost. In this state, it will ferment, and the whole of the earth becomes impregnated with the foul air of the blubber. When this fermentation abates, which it will do

in about two months, I then turn the heap over from top to bottom. The bottom layer of earth, in consequence, becomes the top or cover, and will require some addition to secure the escape of the air by the second fermentation. When this abates, the compost is again turned over; and, after a third fermentation, becomes fit for use. The mixing or applying lime therewith, I have found detrimental. I never use this compost until it is nine or twelve months old. In this state, I have applied to both grass and tillage land about 10 or 15 loads of the compost per acre, each load weighing two tons; and have cut from the grass land three tons of hay per acre, and aftergrass in proportion. I have also used it to tillage crops of wheat, beans, and potatoes, on a field of 20 acres that has not been fallowed for ten years until this present summer, but manured annually in the above proportion, and from which I have reaped five quarters of wheat per acre, five quarters of beans, and from 1,300 to 1,500 pecks of potatoes, with those crops in succession. The land is a strong clay; and the only difficulty from constant cropping is in keeping the land clean from short twitch grass, of which, if left in the land, the blubber encourages the growth."

BLUE (PRUSSIAN). A colouring matter, of a pure dark-blue colour, a dull fracture, inodorous and insipid, insoluble in water, spirits of wine or ether; it is soluble only by the action of corrosive alkalis. The discovery of this colour was accidentally made, in 1704, by Diesbach, a manufacturer of colours, who, with the intention of precipitating the colouring matter from cochineal, with which alum and vitriol of iron were dissolved, procured some alkali from the laboratory of Dippel. This alkali, which Dippel had been heating with some animal matter, produced a beautiful blue precipitate. Dippel, discovering that the alkali had acquired this power of forming a blue precipitate of iron on account of its mixture with animal oil, soon learned to prepare it in a more simple way, since all animal substances, and even all vegetables, which contain much azote, will give the same result. It is, however, necessary, that all the materials should be perfectly pure, since the purification would be too expensive. The addition of alum gives to this blue more body and a brighter colour. This blue substance is a prussiate of iron (52 parts red oxyde of iron, and 48 of prussic acid). The alumine added amounts to from 20 to 80 per cent.; but the greater the quantity, the poorer is the quality of the blue.

BLUEBALL. A variety of awned wheat formerly much cultivated in Somersetshire. The name blueball seems to allude to a darkish colour on the edge of the husks of chaff; or it may refer to the fall of the awns from a portion of the ripened ears, some of the ears having awns, and others being naked. The variety is also called cone-wheat. See the article **WHEAT**.

BLUEBELL. Any native British plant which produces blue bell-shaped flowers. Two species of campanula, and three species of squills appear to be the chief sharers of the name; and one of these species of squills, the *nutans* or *non-scripta*, appears to share most largely both this name and that of harebell. It grows wild in woods, on streamlet banks, and in other shady places in Great Britain, and is one of the most beautiful and fragrant of our native plants,—sometimes profusely adorning a considerable stretch of bank, diffusing an exquisite and very delicate fragrance, and looking almost like a reduced copy of the dark blue varieties of the oriental hyacinth. Its root is a white, coated, globular, acrid bulb; its leaves are linear, channelled, and shining, and droop in their upper half; its flower-stem is succulent, about nine inches long, upright in the lower half, and drooping in the upper; and its flowers are blue, pendulous, campanulate, arranged in a spike like those of a hyacinth, and appear from March till June. The bulb loses its acridity by drying; and, when reduced to powder, serves the same purpose as gum arabic in the art of dyeing.

BLUEBOTTLE,—botanically *Centaurea Cyanus*. A beautiful annual British weed, of the centaury, knapweed, or sweet sultan genus. It grows in corn fields, rising to the height of three feet, delighting the florist with its beauty, but disgusting the agriculturist by its laughing indication of very careless farming. Its root is fibrous and hard; its stem is whitish and firm; its leaves are whitish-green and narrow; and its flowers are blue, and appear from June till August. The plant is sometimes called blue-bonnet, corn-flower, matfellow, wound-herb, and hurt-sickle; and is occasionally admitted to a place in some of the finest plots of a villa flower-garden. An infusion of its flowers is slightly diuretic; a decoction of them with galls and copperas forms a good writing ink; and the expressed juice of them, when mixed with a cold solution of alum, forms a permanent water-colour in painting. The leaves have some popular reputation as styptics, but are really worthless.

BLUE VITRIOL, or **BLUE STONE**,—properly *Sulphate of Copper*. A metallic salt, obtained by evaporating the cupreous water of some copper mines, or by roasting copper pyrites, and exposing them to the action of air and moisture. In the former case, native sulphurets of copper pass, by exposure to a moist atmosphere, into sulphate of copper; and, in the latter, the compound is oxidized, the sulphur acidulates into sulphuric acid, and sulphate of copper is evolved. This salt is largely crystalline, beautifully blue, and perfectly pellucid or semitransparent. It has a very acrid, harsh, styptic taste, is inodorous, and always reddens vegetable blues. It acts very powerfully and somewhat hazardously as a human medicine,—internally as a tonic, an astringent, an emetic, and an antidote to poisoning with laudanum,—and externally, to consume

fungus, and to give a healthy stimulus to indolent foul ulcers. In farriery, it is extremely useful as a mild caustic and detergent, and as an excellent application to almost all kinds of ulcers, disposing them to heal sooner than if they were plied with almost any of the other known remedies. When used in substance, it ought to be reduced to a fine powder, and sprinkled on the ulcers; but it is best used in a state of solution,—prepared by saturating boiling-hot water with the powder, and used either diluted or undiluted according to the particular circumstances of each case. This solution, especially if applied hot, is probably the best known remedy for the excoriations and wounded ligaments of bad broken knees of horses. Small doses of blue vitriol are sometimes administered internally to horses as a tonic; but they are very dangerous, and ought not to be employed. A drachm of it, dissolved in a little gruel, and applied by rubbing, is sometimes useful in prolonged discharge from the nostrils of the ox; and one or two grains of it have sometimes removed the snuffles from rabbits.

BOAR. The male of the swine. See *Hoo*.

BOARD OF AGRICULTURE. See *AGRICULTURAL SOCIETIES*.

BOAT-PLOUGH. See *Plough*.

BOCCONIA. A genus of tender, evergreen, ornamental shrubs, of the poppy-flowered tribe. The frutescent or branching bocconia, also called frutescent celandine, *Bocconia frutescens*, is very common in Jamaica and several parts of America, and was introduced to Great Britain from the West Indies in 1739. Sir Hans Sloane, in his *Natural History of Jamaica*, calls it greater tree celandine with oak leaves. It grows to the height of 10 or 12 feet; its stem is straight, as thick as a man's arm, and covered with a white smooth bark; several branches diverge from the top of the stem, and are embellished with alternately placed leaves; the leaves are of a fine glaucous colour, eight or nine inches in length, five or six inches in breadth, and deeply sinuated, sometimes almost to the midrib; and the flowers have a whitish yellow colour, and appear from January till April. This plant possesses singular beauty, makes an imposing feature in a collection of exotics, and ought to have a place in every tolerably extensive hothouse. Hernandez informs us that the Indian kings planted it in their gardens. A yellow acrid juice, similar to that of the greater celandine, abounds in every part of the plant; and is used by the Americans for removing warts from the skin and spots from the eyes.—Another species, called the entire-leaved, *Bocconia integrifolia*, was introduced to Great Britain from Mexico in 1820; but this, though also an evergreen and of similar habits to the frutescent species, usually grows to the height of only about four feet.

BOERHAAVIA. A genus of tender, evergreen, ornamental plants, of the *Nyctagineæ* tribe. Nearly forty species are known to botan-

ists; and ten of these have been introduced to Great Britain. The inhabitants of the West Indies call the species which grow in their country hogweed, and ascribe to them many excellent virtues. The tuberous-rooted species is reputed to possess the properties of a purgative. One of the species earliest introduced from Jamaica sends out many diffused stems of about 18 inches in length; it has small roundish leaves at each joint of the stem; and its flowers have a pale red colour, and are produced in a very scattered manner upon long branching footstalks from the wings of the leaves, and from the ends of the branches. Another of the early introduced species sends out several stems from each root; and these acquire a length of 5 or 6 feet, trail over all kinds of plants in their immediate neighbourhood, and are much ramified; the leaves are heart-shaped, and grow in mutually opposite pairs, on long footstalks at the joints of the stems; and the flowers are yellow, and grow in loose umbels at the extremity of the branches. *B. excolaa* is an undershrub of about 5 feet in height from South America; *B. scandens* is the climbing species we have just noticed, from the West Indies; *B. diffusa*, *B. procumbens*, *B. hirsuta*, and *B. viscosa*, are trailing evergreens, of about a foot or 18 inches in length, from India, Jamaica, and Peru; and the other introduced species are herbaceous evergreens, of from 1 foot to 3 feet in length, from India, Spain, and South America.

BOG. A superficial and quite recent geognostic formation of alluvial earths and dead herbaceous vegetation, soft, watery, and antiseptic, occasionally intermixed with dead trees or tintured with metallic oxides, and varying in mechanical character from pulverulent or gravelly peat to spongy and aqueous moss. One well-defined variety of it occurs principally on the sides of mountains, and sometimes on not very retentive substrata in low-lying districts, and may be called mountain bog. This consists chiefly of the decayed roots and stems of heath and coarse grasses, but contains some earthy matter; it is of a dark brownish-black colour, and produces heath and coarse grasses; and it varies in depth from a few inches to three or four feet. Another well-defined variety was formed on the site of lakes, or of prolonged or frequent over-floodings of comparatively tranquil water, and may be called lacustrine bog. This consists of the decayed roots and stems of aquatic plants, contains a considerable proportion of both earthy and animal matters, is of a blackish colour, and generally, in its natural state, produces coarse aquatic plants. The fens of Lincolnshire, Cambridgeshire, and Norfolk, consist principally of lacustrine bog, and are the most profitable kind of boggy surface on which the British georgist can operate. A third well-defined variety of bog is the well-known kind called flow or fibrous bog, and often regarded as comprising all the varieties of true bog. It consists chiefly of

numerous species of decayed or decaying moss-plants, with a great predominance of *Sphagnum obtusifolium*; it is deep, wet, and spongy, remarkably antiseptic, and quite or nearly free from earthy ingredients; and, though sometimes occurring on the sides of mountains which have a retentive subsoil, it exists principally in low flat situations, and appears to have, in many instances, grown upon the surface of lacustrine bogs. This variety constitutes Lochar Moss in Dumfries-shire, Chat Moss in Lancashire, and the enormous and many-membered Bog of Allen in Ireland; it has engaged the attention of the most eminent georgists, with a view to its reclamation; and it is bog par excellence, or the only variety of moss formation speculated upon in the vast majority of schemes which have been promulgated, during the last half century, for bog improvement.

When any part of the surface of the earth is so barren as not to produce plants which grow by striking root in the soil, some of the coriaceous lichens and smaller bryums and hypnums, which have no rosette to send into the soil, but lay hold on the surface with their small fangs, and obtain their whole nourishment from air and water, first occupy the ground; and these little vivacious and persistent cryptogams usually thrive and multiply with a rapidity proportioned to the constancy, abundance, and stillness of the plasies and ponds of water spread athwart the surface. When a considerable and permanent supply of water exists, cushions of bryums and hypnums, but especially of *Bryum palustre*, begin to form over the original growths, and serve as dams to detain more water. The *Sphagnum obtusifolium*, in its several varieties, then occupies the hollows; some very branched kinds of lichen grow thick on every hillock; some of the other parasitical and aqueous musci and lichens lend their aid to the accumulation; and thus, in the low, flat, unproductive districts of cold and rainy countries, wherever water is stagnant and husbandry neglected, a thick stratum of living moss is formed, which, by rapid reproduction above and constant decay below, speedily creates an expanse of bog.

When the parasitical plants have formed a spongy mass of sufficient thickness to retain a permanent and plentiful supply of water, and especially when they have effected some degree of decomposition in the lower portion of the mass, they become a fit soil for sturdier and more accumulative marshy plants of our country, phænogamous as well as agamous. The three marsh species of cotton grass, in particular—*Eriophorum polystachyon*, *E. angustifolium*, and *E. pubescens*—very speedily appear and flourish, and are always found in the softest and wettest parts of bogs, the last in England, and the other two in both England and Scotland. Several species of rushes—especially *Scirpus cespitosus*, *S. pauciflorus*, *S. caricinus*, *S. rufus*, *Isoplepis setacea*, and

Eleocharis multicaulis,—soon succeed, and communicate solidity to the spot which they occupy. The roots of some of these rushes, particularly of the attenuated or almost hairy kinds, penetrate deeply into the stratum of mosses; and, along with the roots of the cotton-grasses, constitute the very durable substance which the manufacturers of peat-fuel call ket. A yellow-flowering plant of the asphodel tribe, is also very frequent in wet moss; but it ceases to be distinguishable when any stratum which contains it has passed by decay into peat. A number of other marshy or aquatic phænogamous plants are found in the strata of bogs, and have of course contributed to their formation; but some, though almost uniformly present, are inconspicuous in aggregate bulk; and others, though occasionally making large contributions of substance, are not necessary concomitants of the true peat-forming vegetables. One of the latter class, *Juncus squarrosus*, may be viewed as a sort of representative of the others, particularly of marsh junci; and this, in consequence of its requiring a soil of a more solid consistence than mere moss, is found only in bogs to which age and a mixture of earthy matter have given some degree of solidity; and in bogs of this description, it is sometimes a large ingredient.

But though bog is naturally based on such parts of the surface of the earth as are incapable of originally nourishing any higher tribes of plants than lichens and musci; it is also formed over all soils, however fertile, when their power of exerting fertility is obstructed. Any extensive stagnations of water, whether occasioned by the fall of woods, the choking up of streams, or any other cause of permanent or prolonged operation, may originate bogs; and such stagnations have, in point of fact, given rise to far the largest proportion of the existing bogs which occupy hollow or low tracts of country in the several divisions of the United Kingdom. A writer in the Philosophical Transactions, says, "The Romans under Ostorius, having slain many Britons, drove the rest into the forest of Hatfield in Yorkshire, which at that time overspread all the low country; and the conqueror, taking advantage of a strong south-west wind, set fire to the pitch-trees, of which the forest was chiefly composed, and when the greater part of the trees were thus destroyed, the Roman soldiers and the captive Britons cut down the remainder, except a few large ones which were left growing as remembrancers of the destruction of the rest. These single trees did not long withstand the action of the winds, but, falling into the rivers, intercepted their currents, and caused their waters to rise and flood the whole flat country; hence the origin of the mosses and moory bogs which were afterwards formed there." A principal similar destruction of the portion of the great Caledonian forest which sheeted the upper and middle districts of the basin of the

river Forth, is said to have occasioned the formation of the great bogs along the course of that river; and this, when viewed in connexion with the process of alluvial formation which had there been going on for many ages, perfectly accounts for the character of these bogs, and for the uniformly rich land which lies beneath them, and which is obtained for the purposes of culture by cutting them away. The formation of fens upon great expanses of shallow lake is precisely a kind of stagnation to occasion the growth of the musci, the eriophora, and the cyperaceæ; and can be very distinctly recognised as the origin of flow or fibrous bog in some of the flat districts of England. The levelling surge of some great flood or series of floods westward across the vast limestone plain of Ireland, and the subsequent choking up of its water-courses by the same excess of aquatic vegetation which may still be partially witnessed along the course of the rivers Brosna, Suck, and Shannon, afford a summary explanation of all the great phenomena of the enormous tracts of bog aggregately called the Bog of Allen,—the latter fact accounting for the growth of the bogs, and the former for the flatness of their bed, and the general prevalence beneath it of limestone diluvium and calcareous clays.

In all flats and hollows, which do not possess declivities or free channels for the speedy drainage of surface water, a stratum of moss soon forms, rapidly accumulates, always retains much moisture among its fibres, and is often so soft as not to be able to support the tread of quadruped or man. Little channels are gradually worn athwart this soft substance by the slow but steady flow of the water of heavy rains; and when these deepen, they render the face of the mossy expanse somewhat drier than before, and occasion it to become a congenial soil for the growth of heaths. The heaths cannot grow on moss when it is distended by a great excess of water; but they find it eminently suited to their habits when it becomes somewhat drained and consolidated, and in consequence speedily appear upon such portions of it as are comparatively cleared of water by any process of natural draining. But in the very progress of their growth, they choke up the little channels, occasion a diffusion and stagnation of surface water, and eventually though indirectly secure their own death. The musci now form a new stratum, to be in its turn intersected by little channels, overgrown by heaths, and buried in decay; and thus the bog rises higher and higher, in a process of constant augmentation, by alternate beds of such marsh plants as are altogether aqueous, and such as prefer a comparatively dry but purely vegetable soil. So distinctly and regularly are these alternate beds, in many instances, formed, that, if a perpendicular section of the upper or but partially decomposed portion of a bog be exposed for a year or two to the weather, a somewhat proximate computation might easily be made of its age.

Mere vegetable bog possesses nearly the same character in all situations and under all conditions, varying only according to its age, to the pressure it has undergone, and to the proportions of the several plants of which it is composed. Yet the whole extent of many bogs and large portions of others contain mixtures of mineral substances, and very considerably vary in at once the quantity, the quality, and the mechanical conditions of these substances. Springs which flow into a bog frequently hold some mineral substance in solution, and deposit it, in a permanent and intermixed form, in the bog. Some springs, for example, impregnate a bog with lime, or deposit in it a mixture of calcareous earth; others impregnate portions of a bog with sulphur, and occasion peat-fuel dug from them to emit a sulphurous smell during combustion; and others deeply impregnate parts of bogs with iron, and cause the ashes of their peat to have a rusty red colour, indicating the presence of oxide of iron. But by far the largest and most important kind of mineral admixture is that of earths, carried over the surface of successive strata of bogs, by land floods from higher adjacent grounds. When a large extent of comparatively high ground declines toward a flat bog, the flow of water from it is great and powerful, descends in floods or torrents at every heavy fall of rain, spreads along the border of the bog the alluvial accumulations of clay, sand, and gravel, with which it is laden, and, making gradual advances, sometimes makes earthy deposits athwart every portion of the surface. After the alluvium acquires sufficient thickness to consolidate the mass, the parasitic musci and the eriophora and cyperacea and other marsh plants perish; and land herbage succeeds, more or less adapted to pasture, according to the comparative freedom of the surface from excess of water. Mere vegetable moss, spongy and saturated with moisture, is the most useless and impracticable kind of bog; and, on the other hand, moss which has become naturally consolidated, first with an alluvial deposit, and next with a sward of land herbage, is the most valuable and the least refractory. It yields from its lower strata a solid, warm, and lasting fuel; it affords, after exposure for some time to the weather, a variety of peat-earth which makes an excellent ingredient of compost-manure; it is easily convertible, athwart its surface, into valuable meadow or pasture; and it can, at no great expense, be rendered good soil for the fruitful cultivation of both green and cereal crops.

The formation of some bogs upon shallow pools or lakes is rendered probable by the resemblance of their site to the lacustrine expansion of a river-course, and almost or altogether certain by the existence of beds of shells and calcareous marl at their bottom. The probable process of the formation is thus stated in the Report of the Ordnance Survey:—"A shallow pool induced and favoured the vegetation of aquatic plants, which

gradually crept in from the borders towards the deeper centre. Mud accumulated round their root and stalks, and a spongy semi-fluid moss was thus formed, well-fitted for the growth of moss, which now, especially sphagnum, began to luxuriate. This, absorbing a large quantity of water, and continuing to shoot out new plants above, while the old were decaying, rotting, and compressing into a solid substance below, gradually replaced the water by a mass of vegetable matter. In this manner, the marsh might be filled up, while the central or moister portion continuing to excite a more rapid growth of the moss, it would be gradually raised above the edges, until the whole surface had attained an elevation sufficient to discharge the surface-water by existing channels of drainage, and calculated by its slope to facilitate their passage, when a limit would be in some degree set to its farther increase." The surface strata sometimes became a floating mass by the decay of the roots which were attached to the ground; and they, in a great degree, consist of long interlaced fibres, which the Irish separate from the rest of the bog, and call old wives' tow. The decomposed roots and vegetable fibres constitute a paste of black mud, not heavy enough to sink to the bottom, and so mixed with the water below the floating superficial strata as to constitute what is termed a quaking bog. The vegetation on the surface of the floating strata has often the appearance of green sward; and the roots are sometimes so strong and matted as to form an elastic web-work sufficient to bear the light and rapid tread of an expert 'bog-trotter.'

The vegetable material of bogs does not ferment and decay in the rapid manner of land herbage, but is slowly decomposed in a similar manner to the duramen or perfect wood of trees. The upper strata of every bog which has not become carpeted with alluvium, or otherwise deprived of its purely mossy character, are always in a living or but very slightly decayed state; and the strictly superficial stratum is never older than a single year,—the superficial stratum of any one year being succeeded by a new growth in the next. The resistance of putrefaction on the part of the upper strata is the main reason why they cannot, in their natural state, yield nourishment to land plants; and it is occasioned, not by any acid or peculiar chemical principle in the strata, but by the special organic constitution of the moss plants, by their great elasticity, and by their acting in both their living and their half-decayed state, as sponges for retaining large quantities of water in a stagnant condition. Moss, while undecayed, is specifically lighter than water; while decaying, decreases in lightness and bulk; when fully decayed, is comparatively compact, and somewhat heavier than water; and when reduced to its final condition, is deprived of all such portions as can be dissolved in water and carried off by slow currents, retains most of the ingredi-

ents which were deposited as alluvium or intermixed by mineral impregnation, and is at once heavier, more consolidated, and farther removed from organic character than more fully decayed moss. Such portions of the moss plants as are soluble in water during the progress of their decay, may be made to contribute nourishment to useful vegetation; and such portions as most powerfully resist putrefaction, may be accelerated in their decomposition, and forced into a condition of fitness for the partial sustenance of useful plants, by top dressings and intermixtures of earthy substances. When a deposit of alluvium is made on the border of a bog by land-streams, or a top dressing is spread on its interior surface by the hand of georgic improvement, an increase in fertility is soon observable, both too rapid in progress and too large in amount, to be possibly produced by the mere presence of the earthy matters, or ascribable to any cause but their decomposing power upon the moss-plants.

The aggregate extent of bog in Great Britain and Ireland is so exceedingly great, and at the same time so widely spread, as to render it eminently worthy of the attention of many farmers, most landlords, and all scientific georgists. The mountain bogs of Scotland are very abundant in most of the highland districts; but, with few exceptions, are capable of only slight improvement for the purposes of upland pasture. A great extent of bog of various character, from moorland to flow moss, lies dispersed throughout many parts of the Scottish lowlands, particularly in Aberdeenshire, Kincardineshire, and the districts of Carrick and Galloway. A considerable aggregate of deep flow bog stretches along the banks of the middle part of the river Forth, and was, in one part, the scene of the celebrated bog-improving operations of Blair-Drummond; and a very extensive flow bog, in several respects the most curious in the three kingdoms, and bearing the name of Lochar Moss, occupies the site of a great quondam arm of the sea in Dumfries-shire, down to the shore of the Solway frith.

Mountain bogs abound among the uplands of Northumberland, the mountains of Wales, the great hilly range of the south of England, and some of the hilly portions of the English midland counties. A vast tract of lacustrine bog expands around the region of the Bedford Level, principally in the shires of Cambridge and Lincoln. A tract of flow bog, about six miles in length and three miles in extreme breadth, is traversed by the railway between Liverpool and Manchester, and exhibits a vast accumulation of pure mossy matter, without the slightest admixture of sand, gravel, or any other earth.

But Ireland, as all fame has long ago proclaimed, far exceeds Great Britain in the proportion which its bogs maintain to the rest of its territorial area. The Irish bogs are exceedingly variable in depth, wetness, and consistency; but the larger proportion are either quite level or

very slightly sloped bogs, situated in low plains or athwart the far-spread summits of low tablelands; and many of these are completely saturated with water, spouty, fennish, and intermixed with quagmires; while most are reddish in colour, spongy in consistency, the same in character as the flow mosses of Great Britain, and distinctively designated by the Irish red bogs. Mountain bogs lie at nearly all altitudes above sea-level,—from the skirts of the mere hills to the higher acclivities of the loftiest mountains; and they consist, for the most part, of thin sheets or strata of peaty matter, dry, firm, and easily reclaimed. The Commissioners appointed to inquire into the nature and extent of the bogs of Ireland, say, "A portion of Ireland, of little more than one-fourth of its entire superficial extent, and included between a line drawn from Wicklow-Head to Galway, and another drawn from Howth-Head to Sligo, comprises within it about six-sevenths of the bogs in the island, exclusive of mere mountain bogs, and bogs of less extent than 500 acres, in its form resembling a broad belt drawn across the centre of Ireland, with its narrowest end nearest to the capital, and gradually extending in breadth as it approaches to the western ocean. This great division of the island, extending from east to west, is traversed by the Shannon from north to south, and is thus divided into two parts; of these the division to the westward of the river contains more than double the extent of the bogs which are to be found in the division to the eastward; so that if we suppose the whole of the bogs of Ireland, exclusive of mere mountain bog and of bogs under 500 acres, to be divided into twenty parts, we shall find about seventeen of them comprised within the great division we have now described, twelve to the westward, and five to the eastward of the Shannon, and of the remaining three parts, about two are to the south and one to the north of this division. . . . Most of the bogs which lie to the eastward of the Shannon, and which occupy a considerable portion of the King's county and county of Kildare, are generally known by the name of the Bog of Allen; it must not, however, be supposed that this name is applied to any one great morass; on the contrary, the bogs to which it is applied are perfectly distinct from each other, often separated by high ridges of dry country, and inclining towards different rivers, as their natural directions for drainage, and so intersected by dry and cultivated land, that it may be affirmed generally there is not a spot of these bogs to the eastward of the Shannon, so much as two Irish miles distant from the upland and cultivated districts." The total extent of the red or wet champaign bogs of Ireland, including an estimated amount of the multitudinous small ones, is 1,576,000 acres; and the total extent of peat soil, forming the covering of mountains, is 1,255,000 acres.

The depth of the flow bogs of Scotland is com-





monly from 4 to 8 feet, sometimes from 8 to 16 feet, and very rarely more than 20 feet; but that of the red bogs of Ireland is seldom less than 12 feet, sometimes about 42 feet, and on the average about 25 feet. "The bog," say the Irish Commissioners, in reference to the latter, "varies materially in its appearance and properties, in proportion to the depth at which it lies. The upper surface is covered with moss of various species; and, to the depth of about ten feet, is composed of a mass of the fibres of similar vegetables in different stages of decomposition, proportioned to their depth from the surface, generally however too open in their texture to be applied to the purposes of fuel. Below this generally lies a light blackish-brown turf, containing the fibres of moss, still visible though not perfect, and extending to a further depth of perhaps ten feet under this. At a greater depth, the fibres of vegetable matter cease to be visible, the colour of the turf becomes blacker, and the substance much more compact, its properties as fuel more valuable, and gradually increasing in the degree of blackness and compactness proportionate to its depth. Near the bottom of the bog, it forms a black mass, which when dry has a strong resemblance to pitch or bituminous coal, having a conchoidal fracture in every direction, with a black shining lustre, and susceptible of receiving a considerable polish." In *Plate IX.* are a view and explanations of a section of a turf-bank in the Bog of Allen, which particularly elucidate this statement, and at the same time afford some illustration of the general account we have given of the formation of bogs.

The question of the reclamation of bogs has been a subject of keen debate, and cannot be regarded as yet settled. The Commissioners on the Bogs of Ireland say, "It may naturally be expected that we should express our opinion whether any, and what general measure should be adopted to further the reclamation of this great extent of land, at present so unprofitable, and which the concurrent testimony of every person, except one, whom we have employed, represents as not merely susceptible of improvement, but as promising to afford a greater profit on the operation than perhaps any other application of agricultural skill and capital. Various as are the modes of improvement, and the estimate proposed by our different engineers, we consider that the fair average of their opinions, that by an expenditure of from £1 to £20 per acre, the reclamation would secure to the improver a permanent rent of from 10 to 15 per cent. on the expenditure. Some of them on whose judgment we place great reliance, are even of opinion, that the whole of the capital employed would be returned by the produce of the first crops which effected the improvement. Supposing, then, the capital employed to be finally lost, still the rent obtained would abundantly compensate for its application; but on the other supposition, of the capital itself

being repaid, it would follow that the rent would finally become the reward merely of the skill and labour of the improver. Nor is it on mere theoretical speculation that these premises are rested. Our engineers uniformly adduce the example of hundreds of acres actually improved within their respective districts, to justify their estimates. It may, perhaps, then be inquired, why all these bogs have not long since been improved? or it may be asserted, that their present desolation in the midst of so much apparent inducement, is in itself a sufficient proof that such premises must be practically fallacious. We are convinced, however, that this circumstance may be otherwise accounted for, and that it is not to physical obstacles that the present situation of these wastes is principally to be ascribed. The arable lands around the extremities of each bog, belong, pretty generally, to a great variety of proprietors, the mearings of whose estates, it is generally admitted, must be contained within the area of the interior bog, but the precise situation of which is seldom ascertained. The external boundary of the bog forms a turf bank; the interior is a quagmire, in its present state inapplicable to any other purpose than the affording a very scanty summer pasture to a few wandering cattle, who are turned in to seek for it, at the risk of being lost. The cultivators who occupy the contiguous farms have usually annexed to the enjoyment of the lands a right of turning in their cattle on the part of the bog adjoining to their respective farms; and when these are tempted by hunger to wander further, reciprocal convenience forbids its being considered as a trespass. These farmers have usually terms of lives or years in their holdings too short to tempt them, even if possessed of capital and of skill, to enter on the permanent improvement of the bog, while they are yet abundantly sufficient to render such an operation impracticable for the landlord. The landlord has demised to the tenant a vague possession of what he considered of little or no value; the shortness of the tenure obliges the tenant to leave his holding in its unprofitable state; but were the landlord to propose to improve it, the tenant having a present right to prevent him, that right would become valuable just in proportion to the intended exertions of the landlord, and would inevitably be set up by the tenant."

A writer in MacCulloch's *Statistical Account of the British Empire*, says, by way of critique on this statement of the Commissioners, "The bogs are generally, indeed, at such an elevation above the sea as to allow of drains being cut to a depth sufficient to permit the escape even of the bottom water. But the Commissioners observe, that 'the bogs partake of the nature of a sponge, and are completely saturated with water.' Although, therefore, a vent were made for the bottom water, it does not follow that the water held in suspension by the bog could also be carried off. On the contrary, experience shows that,

when drains are cut through a bog, though at no considerable distance from each other, the intermediate portion continues nearly as wet as ever. But supposing that this apparently insuperable difficulty were overcome, and that the bogs were completely drained, still we have to inquire whether any advantageous result would follow. According to Mr. Wakefield, the drainage of the bogs would render them 'masses of dry inert vegetable matter; and unless some means were discovered of bringing it into a state of putrefaction, one might as well attempt to cultivate an immense wool-pack.' The fact is, that, in the present state of the bogs, nothing but a covering of earth, clay, marl, or limestone and gravel, will do any good; and this can be applied better without large surface drains recommended by the Commissioners, than with them. The elaborate estimates given in the reports of the engineers employed by the Commissioners of the expense of draining and improving bogs, are altogether hypothetical, and are entitled to very little weight. Had a single extensive bog been drained by speculators, and brought into a state of profitable cultivation, there would have been some foundation to go upon. This, however, has not been done; and, till it be done, there are plainly no data to refer to in relation to this subject on which any reliance can be safely placed. We do not mean to insinuate that we look upon the cultivation of the bogs of Ireland as impracticable; should the wealth of the country increase, they will, no doubt, be gradually, though we believe very slowly, reclaimed. At present, however, we confess it appears to us that there are no grounds for thinking that their cultivation, if undertaken upon a great scale, would be otherwise than ruinous. Even in Great Britain, most of those who have distinguished themselves by attempts at bog improvement have been heavy losers. Blair-Drummond moss, in Perthshire, has not been improved but exterminated. And it is abundantly obvious that, in Ireland, the chances of loss from any public improvement would be incomparably greater."

Sir C. G. Monteath, Bart., of Closeburn, a well-known, enlightened, extensive, and most successful georgist, fully admits all the difficulties and pecuniary hazards of the various methods of bog improvement suggested previous to 1838, and yet has confidence that all flow bogs, as well as all the worst varieties of lacustrine bogs, may, by a new method, be certainly and economically reclaimed. He states that he would so far follow previous improvers as to drain off the astringent water from any flow bog, in order to consolidate the upper stratum and arrest its growth, and to apply quicklime and earthy matters in order to accelerate its decomposition and assimilate it to the nature of our more prolific soils; and he adds, "All this and no more has been done already, and yet it is found inferior to the lacustrine or fen bog, and is still considered a dan-

gerous subject for the investment of capital. The cause of this is a subject worthy of inquiry, and one which does not appear to have been hitherto accounted for. The following is my view of it. Although we may have succeeded in assimilating the soils, still there exists a material difference between the subsoils. In the case of the lacustrine bog, there is more or less earthy matter to the very bottom, by which a due circulation of moisture is promoted,—a circumstance which, in my opinion, is of the greatest importance to both soils and subsoils. But, in the case of the flow bog, all below the soil is a mass of dead inert peaty matter, almost impervious to moisture and air; and the moisture it does contain must be of an astringent and pernicious quality, and injurious to vegetation. In order to remedy this evil, I would propose, after the bog has been drained and consolidated, to lay an artificial subsoil of clay, sand, and gravel, three, four, or more inches in thickness, at the depth of about eight inches under the surface, so as to cut off all connexion with the lower portion of the bog. By this means all the pernicious moisture rising from below will undergo an important chemical change in its passage through the subsoil. The subsoil will also make the soil more firm, and whenever we see bog resting on a sufficiently earthy subsoil, we generally find it productive, unless the soil is very ferruginous. The manure will have more effect. The soil will decompose more freely, especially if an inch or two of its surface has been burned; and it will ultimately be converted into a rich moory loam, fit for the cultivation of most crops, especially if it has had a due admixture of earthy matter, and certainly in the case of an artificial subsoil much less will suffice. If then my views are correct, this would be a permanent improvement to bog, and on that account would amply repay any additional expense which would be incurred over ordinary methods, which, in fact, have been mostly found ineffectual. I have little doubt that a fair trial would, in a few years, demonstrate its complete success; and thus, by and by, we would see some millions of acres of dreary, dull, worthless, waste bog, converted into rich smiling corn fields and meadows, and the climate improved. I allude more particularly to Ireland. It is a remarkable fact, that wherever bogs occur, especially in this country, the elements for their improvement are at hand. We have here in our diluvial deposits the best of clay, gravel, and sand, for the purpose, being chiefly of a calcareous nature. On the verge of Lochar Moss, if my memory is correct, are deposited abundance of materials from the greywacke and new red sandstone formation, admirably adapted for its improvement. As a means which this would afford of ameliorating the condition of the labouring classes of this naturally highly-favoured country, it is superfluous to speak."

The use of bogs as turbary has frequently been

urged as a reason for not attempting to improve them; but if properly viewed, is really a strong inducement to the reclamation of at least all large bogs. Turf for fuel can at present be obtained from only the borders of these bogs, their interior being rendered useless and even inaccessible by excessive moisture; but, were they reclaimed, turf might be cut from reserved pendicles in any part of them, and in consequence obtained in an hundredfold or even thousandfold greater quantity. The subject of bog-fuel affects all Ireland, all the Scottish Hebrides, much of the Scottish Highlands, and a considerable portion of the British Lowlands; and it possesses, in these districts, an engrossing degree of economical interest of which the inhabitants of coal countries can form little conception. Mr. Bicheno remarks, "The rainy climate of Ireland, and the wet occupations of the people, with the nature of their food, make a fire more important to them than to most others, and, in fact, is frequently the substitute for clothing, bedding, and, in part, shelter. Had it not been for the bog, the measures taken in former times to extirpate the nation might probably have succeeded; but the bog gave them a degree of comfort upon easy terms, and enabled them to live under severe privations of another kind." Light fuel-turf, cut from the surface strata of a flow bog, is only two-fifths the weight of water. A cubic yard of this light turf, closely packed, weighs 500 pounds; of good turf, 900 pounds; and of very dense turf, 1,100 pounds. Light turf yields about 74 per cent. of volatile matter, 23 of charcoal, and 3 of ashes; and dense turf yields 71 per cent. of volatile matter, 21 of charcoal, and 8 of ashes. Bog turf, even its best natural varieties as prepared for fuel, wants sufficient density for many economical purposes, and, though yielding a vast body of volatile inflammable ingredients, evolves at no one point an intense heat; but when mechanically compressed into a condition in which it may be sold in Ireland for from 6s. to 8s. per ton, it possesses a calorific power little inferior to coal; and when so carbonized as to cost not more than 20s. per ton, it yields about 30 per cent. of fine coherent coke, of greater density than that of wood charcoal.—*Reports of the Commissioners on the Bogs of Ireland.*—*MacCulloch's Statistical Account of the British Empire.*—*Dr. Kane's Industrial Resources of Ireland.*—*Ordnance Survey of the County of Londonderry.*—*Philosophical Transactions.*—*Sir John Sinclair's General Report of Scotland.*—*Quarterly Journal of Agriculture.*—*Rham's Dictionary of the Farm.*—*Mill's Husbandry.*

BOG-ASPHODEL, — botanically *Narthecium Ossifragum*. A curious, herbaceous, evergreen, indigenous plant, of the rush tribe. It grows wild in the turf bogs of both England and Scotland. Its root is tuberous; its stem is smooth, fine, rigid, roundish, leafy, and from 3 to 8 inches high; and its flowers are spreading and of a bright

yellow colour, with scarlet anthers, and appear in July and August. It acquired its specific name of *ossifragum* or bone-breaking, from its supposed power of softening the bones of cattle which feed upon it; but it has been fully proved to possess neither this power nor another one ascribed to it,—that of causing the rot in sheep.

BOG-BEAN,—botanically *Menyanthes trifoliata*. This plant, which is generally distributed in Britain, growing abundantly in marshy places, peat-bogs, and by the sides of lakes and pools, is one of the most beautiful of our native species. It belongs to *Pentandria monogynia* of the Linnæan system, and to the natural family of *Gentianeæ*. The root is perennial, long, creeping, jointed, and sends out numerous verticillate white fibres. The leaves are alternate, petiolate, ternate, the leaflets obovate, thick, smooth, and deep green. The flower stalk rises to the height of from six to ten inches, and supports an oblong or conical raceme of numerous very beautiful flowers, which are pentapetalous; the corolla previous to expansion rose-coloured externally, afterwards reddish-white, the petals on the inner surface covered with numerous fringe-like white filaments. All parts of this plant are extremely bitter, and in some countries it is used as a substitute for hops in the preparation of ale. The root, although almost equally bitter, Linnæus informs us, is dried and powdered by the poorer people in Lapland, to be made, with a little meal, into a coarse unpalatable bread. In this country the plant is not applied to any use, if we may except its occasional employment in some parts of the north of Scotland, as a purgative for calves. Formerly it was much employed in various chronic diseases, as scurvy, dropsy, jaundice, asthma, and gout, the paroxysms of the latter of which complaints it was supposed to keep off, but at present it is neglected on account of the preference given to gentian and other bitters. There can be no doubt, however, that, as an astringent and stomachic, it is equally powerful with many exotic plants.

BOG-EARTH. Dry powdery black bog, in a state of mechanical mixture with silicious silt or with any finely-powdered variety of mineral alluvium. The most esteemed kind of it comprises about twenty-five per cent. of vegetable matter, and has the appearance of a blackish and very fine mould; and this is in high request among gardeners as the most suitable soil for many kinds of flowering plants, particularly some of the American shrubby kinds; and when artificially combined with good ordinary mould, or occasionally some quicklime, it acts much better, both stimulatingly and nutritively, than any description of artificial manure. It may be obtained sometimes on the surface, but particularly on the borders, of drained and improved bogs, whose natural growth was arrested and terminated by alluvial depositions; and sometimes in superficial alluvial beds, formed over

clays or other impervious substrata, by the silty sediments of streams flowing remotely from bogs. Artificial imitations of it—in many instances very similar to itself in ultimate composition, and little if at all inferior in manurial action—are often made by mixing the light mud of ponds and ditches with leaves, weeds, and grasses, in pits or little reservoirs, frequently turning and watering the mixture, and finally exposing it in heaps to the air till it acquires the requisite consolidation and pulverulence. The kind of bog earth, which forms a suitable ingredient of coarse composts for field farming, is more frequently designated peat earth or simply peat, and consists simply of the more compact or peaty portions of bogs, laid open to the weather till they become dry and powdery.

BOG-ORCHIS,—botanically *Malaxis*. A genus of herbaceous plants, of the orchis tribe. The marsh species, *Malaxis paludosa*, is a perennial, of delicate appearance, and grows wild in the wet spongy bogs of England. Its root is bulbous, and increases by offsets; its stem is angular, smooth, and about 3 inches high, and is one of the smallest belonging to our native orchidæ; its leaves are ovate, various in length, and three or four in number; and its flowers are produced at the top of the stem in a dense cluster, have a yellowish-green colour, and appear in July. About a dozen other species are known to botanists; but none of them grow or are cultivated in Great Britain.

BOG-RUSH,—botanically *Schænus*. A genus of grassy-looking plants, of the rush tribe. The blackish species, *Schænus nigricum*, grows wild on the spongy bogs of Britain. Its root has a comparatively great length, and consists of strong fibres, crowned with erect, folded, glossy-black sheaths; its leaves are upright, acute, and very narrow, and arise from some of the sheaths at the crown of the root; the stem is chiefly naked, but partly embraced by the sheaths, and shaded by the leaves, and attains a height of about a foot; and the flowers have long yellow anthers and dark purple stigmas, and appear in July. Three half-tender species were introduced a few years ago from New Holland and the West Indies; and a hardy species, *Schænus mucranatus*, was introduced about sixty years ago from the south of Europe. Upwards of sixty other species are known to botanists.

BOG-SPAVIN. A soft tumour, of the nature of a windgall, on the hock of the horse. Dr. Bracken regarded it as a collection within a bag or cyst of the brownish, gelatinous, or mucous matter which naturally serves for lubricating the joint,—the common membrane which encloses the joint forming the cyst; and he illustrates both the disease itself and the mode of treating it by an instance which occurred in a young colt of his own. He found that, by pressing the spavin hard on the inside of the hock, a small tumour appeared on the outside, and he

therefore concluded that the disease had its seat in the inside; and he cut into it, discharged a large quantity of the glutinous or mucous matter, dressed the sore with dossils dipped in oil of turpentine, and put into it, on every third or fourth day, a powder composed of calcined vitriol, alum, and bole. By this treatment, the tumour sloughed off, and came away; and a complete cure was effected without leaving any scar. But a less critical method, and indeed the only one with which any ordinarily bad case of bog-spavin can be prudently attacked, is, by means of blistering or of firing, to excite the absorbent vessels in the interior of the limb, and immediately around the seat of the disease, to carry away the encysted fluid which constitutes the tumour. The majority of cases, however, will resist even this method; and all cases occurring in the draught-horses of a farm, or in any other horses not required for rapid action, ought to be entirely let alone. Bog-spavin often induces permanent though not very great lameness; it is, in every instance, a decided unsoundness in a horse; and when removed by skilful medical treatment, it is very liable to be reinduced.

BOIL. An inflamed and suppurating tumour in any of the fleshy parts of cattle or sheep. A boil ought to be brought to a head by the application to it of a plaster composed of wheat flour, yolks of eggs, and tar; and when it feels soft to the touch, it ought to be opened with a lancet, in order that the purulent matter may escape. Ellis recommends that, after it has been opened and freed from pus, it first be anointed with ointment of tobacco, and next covered with a plaster made of equal parts of turpentine, burnt salt, honey, and galbanum, and about a quarter more than an equal part of resin.

BOILING, or EBULLITION. The rapid expansion of a liquid by heat, and violent escape of successive portions of it in the form of vapour. In ordinary evaporation, a liquid passes off slowly, quietly, and insensibly; but in boiling or ebullition, it escapes rapidly, tumultuously, and very visibly—balls of vapour rising from the bottom or sides of the body of the liquid, of so great size and in such swift succession, as to cause a tumbling commotion through all the interior, and a clouding aloft of steam from the top. The heat requisite to produce ebullition, or what is technically called the *boiling point* of liquids, widely varies in different kinds of liquids, and is considerably affected in any one liquid by some modifying conditions. The boiling point of sulphuric ether, in ordinary circumstances, in the open air is 96° of Fahrenheit; of alcohol, 176°; of water, 212°; of oil of turpentine, 316°; and of mercury, 662°; and, in the case of any one liquid, it is uniform in the same circumstances, or under the same conditions, but suffers variation when some of the circumstances or conditions are altered. For example, when the barometer stands at 30 inches, water boils at 212° in a me-

tallic vessel, and at 214° in a glass vessel; when the barometer stands at less than 30 inches, water boils at a lower temperature than 212° ; when the barometer stands at more than 30 inches, water will not boil except at a higher than 212° ; and when atmospheric pressure is totally removed from a close vessel by means of the air-pump, water boils at so low a temperature as 72° . The pressure of the atmosphere on the summit of a mountain or lofty hill at any one moment is always less than in the adjacent plain or valley; and water, in consequence, always requires more heat to bring it to ebullition in a valley than on a hill. An elevation of 530 feet makes a difference of one degree of Fahrenheit in the boiling point of water; and every subsequent elevation of 530 feet makes a difference of another degree; and so constant is this ratio, that, but for the disturbance of pressure occasioned by meteorological vicissitudes, it might be made a facile and perfectly exact means of determining the height of mountains. All other liquids, as well as water, boil at 140° lower temperature in vacuo than in the open air. Water in a vacuum, as in the instance of the common pulse glass, will boil by the heat of the hand; and sulphuric ether in a vacuum will boil at a temperature low enough to freeze mercury.

The process of boiling is well known to effect great and important changes in both the chemical and the mechanical condition of food, and to render many substances suitable for the digestion of man and beast, which, in their raw state, are indigestible, or even inedible, or unwholesome. A boiling house for the preparing of cattle's food, and for various other purposes requiring the use of hot water, is now an indispensable part of every proper series of farm buildings, and ought to be situated in the immediate vicinity of the cow-house. Moveable boilers or boiling-machines can serve only for very small establishments; and either fixed boilers of the construction common in this country, or caldrons of a semi-conical shape suspended on a crane, and loosely inserted in an inverted semicone of brickwork, are requisite for all farms which have a large home stock. In these vessels, roots may be reduced from hardness to an eatable condition; chaff, weak corn, and other kinds of barn refuse, may be rendered palatable and more nutritive; hay-tea may be prepared, as an agreeable and nourishing drink to sick cattle; food may be cooked for swine and poultry; and water may be boiled for steeping harsh articles of food, or for any other of scores of useful purposes. But the same kind of chemical and mechanical changes which are made on the food of cattle by boiling in water, are effected also, and generally with greater advantage or in a superior degree, by the action of steam; and they will afterwards be the subject of a separate notice. See the article STEAMING.

BOKHARA CLOVER. See CLOVER.

BOLE. The branchless part of the trunk or

stem of a tree. The boles of most kinds of timber trees constitute the principal body of a forest. The name bollings is applied in some districts of Britain to pollards or the stems of young trees freed from the tops and the branches. See the article TREE.

BOLE. A viscid earth, less coherent than clay. A variety of it has usually a yellow tinge. All the kinds of it are recommended as astringents and sudorifics. The chief sort used in medicine is imported from Turkey, and will be found noticed under the head ARMENIAN BOLE.

BOLETUS. A genus of fungi, having a globular form, and taking their name from a word which signifies a mass. Eight or nine species, besides several varieties, grow wild in Great Britain; and about a dozen other species are known to botanists. The milk-flowing species, of a buff colour, and about $2\frac{1}{2}$ inches broad, grows in pastures; and the other eight British species grow in woods. Three of these species have a cracked form, one has a frosted appearance, four have each a breadth of about 3 inches, and the other two have a breadth of respectively $2\frac{1}{2}$ and 4 inches; and most may be seen during both summer and autumn.

But the most interesting boletus is one which has a place in the British materia medica. "This species of fungus," says Dr. A. T. Thomson, "is found in Britain growing upon decayed trunks of the ash and the oak. The pileus or hat is scaly and convex, but depressed in the centre. When young, it is of a light brown colour above, and soft like velvet, white underneath, and covered with a slimy matter; but when mature, it changes to dark brown, approaching to black. It is from 6 to 10 inches in diameter; and although generally stemless, yet it is sometimes supported on a footstalk an inch in length. The boletus which grows upon the oak is said to be the most valuable. It should be gathered in August or September, and be kept in a dry room. The way of preparing it is to take off with a knife the white and hard part, till you find a substance so soft as to yield under the finger like shammy leather. This must be divided into different pieces, and these beaten with a hammer till they become so soft as to be torn with the finger." Boletus, thus prepared, contains resin, extractive, several salts, and a principle similar to animal gelatine. Its principal use is as an external application to bleeding arteries and veins; and is the same as that of lint or sponge.

BOLL. A Scottish measure of grain. It is generally understood to contain four bushels. But in the old Scottish measures of oats and barley, four lippies were equal to one peck, four pecks to one firloft, four firlofts to one boll, and sixteen bolls to one chaldron. A boll of oatmeal weighs 140 pounds; and three-fourths of a boll of oats is equal to a boll of wheat, pease, or rye.

BOLLING. The rolling inward and amassing of the leaves of some of the varieties of *Brassica*

oloracea into heads. The principal varieties which boll are savoys and all the common kinds of cabbage. Bolling is often called by the English cabbaging, and corruptedly by the Scotch boeing.

BOLTING. The separating of flour or meal from husks or bran, by a process of sifting. A framed sieve, with a bottom of linen-cloth, hair-cloth, or fine wirework, is employed for the process, and called a bolter; and a mill or machine, enclosing the bolter, and having a high degree of lateral or circular motion, is called a bolting-mill. The cloth for the sieve is made of different degrees of fineness, and designated by numbers to express its comparative quality. Bolters which can be worked by the hand are used by bakers; but large ones, kept in motion by the common moving-power of the mill, are used by millers. A hand-bolting-machine is in much use, consisting of a half cylinder of wire, with cross brushes enclosed in a box, and costs from three to five guineas.

BOLUS. See BALL.

BOMBAX,—popularly *Silk-Cotton-Tree*. A genus of evergreen, tropical timber trees, forming the type of the order *Bombaceæ*. This order comprises the genera *adansonia*, *eriodendron*, *bombax*, *ochroma*, *durio*, *helicteres*, *plagianthus*, *carolinea*, *montezuma*, *cheirostemon*, and *myrodia*. Most of the species are fine lofty trees, with large showy flowers; and some of them are among the bulkiest and most imposing trees in the world. Yet the *bombaceæ*, notwithstanding their dendritic character and their general stupendousness and magnificence, were formerly included in the prevailingly herbaceous order of *Malvaceæ*, and are botanically distinguishable from the plants of that order only by an imbricate construction of their calyces, and by the collocation of their stamens into five sets or brotherhoods. The flowers of some are very large and gorgeous; the timber of all is light and soft, and fit chiefly for the construction of canoes; and the medical properties of any seem to be quite or nearly the same as those of the mallow-plants. About thirty of the species are grown in the hothouses of Great Britain.

Two of the best known species of silk-cotton-tree are *Bombax ceiba*, or *Bombax quinatum*, and *Bombax pentandrum*, or *Eriodendron anfractuosum*. The former of these was introduced to Great Britain from South America in 1692, and the latter from the East Indies in 1739; and both usually grow to the height of about 100 feet, but sometimes attain a height of about 150 feet, and are the tallest and bulkiest specimens of the genus. Their trunks are so vast as, when scooped out, to make very large canoes. On occasion of the first voyage of Columbus, a canoe, made of the hollowed trunk of one of these trees, was seen at the island of Cuba, ninety-five palms in length, of proportionally great breadth, and of so large a capacity as to contain 150 men. "Some

modern writers," says Miller, "have affirmed that there are trees of these sorts, now growing in the West Indies, so large as not to be fathomed by 16 men, and so tall as that an arrow cannot be shot to their top." The stems of both species are very straight; but those of the one are closely armed with short strong spines; and those of the other are perfectly smooth, and pass, at successive ages of their existence, from a bright green colour, to a grey, an ash-colour, and a brown. Side branches seldom grow from either till it has acquired a considerable height; and only the tops of the branches are garnished with foliage. The leaves of both species are digitate, each consisting of five, seven, or nine small, smooth, oblong, spear-shaped leaflets, joined to one centre at their base, and there adhering to a long footstalk. The trees, however, are evergreen in only a modified sense, shedding their leaves annually, and being for some time destitute of foliage; but before the new leaves come out, the flower-buds appear at the ends of the branches; and, soon after, they expand. Each flower has five oblong petals, which are white in the *ceiba* and scarlet in the *pentandrum*; and the fruit is as large as a swan's egg, has a thick ligneous covering, opens when ripe into five parts, and is full of a dark short cotton, enclosing numerous roundish seeds about the size of pease. The cotton is used by the poorer inhabitants of the tropics for stuffing chairs and pillows, but is supposed to give off unwholesome effluvia; the seeds are said to be eaten by the inhabitants of the island of Celebes; a solution of the gum, in conjunction with spices, is medicinally administered in certain stages of bowel complaints; and the wood is used by the Mootchie men for making rafts.—The species which have been introduced to the hothouses of Great Britain are *B. malabaricum*, or *heptaphyllum*, from Malabar; *B. globosum*, from Guiana; *B. septenatum*, from Carthage; *B. ceiba* or *quinatum*, from South America; *B. erianthos*, or *Eriodendron leiantherum*, from Brazil; *B. pentandrum*, or *Eriodendron anfractuosum*, from the East Indies; *B. gossypium*, or *B. grandiflorum*, or *Cochlospermum gossypium*, from the East Indies; and *B. vitifolium*, or *Cochlospermum serratifolium*, from Mexico.

BONDAGER. A day-labourer or field-worker on a farm. The designation seems to have arisen during the feudal period, and has been perpetuated in consequence of every first class ploughman being bound to provide a day-labourer; but it is now a mere nickname, or epithet of degradation; and it ought to be discontinued. Most of the labourers usually designated bondagers are women. See the article FARM-LABOURERS.

BONDUC, or **NICKER-TREE**,—botanically *Guilandina*. A genus of shrubs or small trees of the pea tribe. Seven species are known to botanists; and two of these, both ornamental, evergreen shrubs, were long ago introduced from India to the hothouses of Great Britain. The greater

bonduc, *Guilandina bonduc*, usually grows to the height of 12 or 14 feet, twines around any neighbouring support, and is armed athwart its stem, with crooked thorns. Each leaf is usually 18 inches in length, and doubly pinnated; its primary wings amount to 6 or 7 pairs; its leaflets or secondary wings are oval, and entire, and amount to 6 or 7 pairs on each primary wing; and its footstalk or principal midrib is armed with thorns similar to those of the stem, but smaller. Its flowers have a yellow colour, and are produced in long spikes from the wings of the stalk; and its pod is about 3 inches long and 2 broad, closely armed with slender spines, opening with two valves, and containing hard yellowish seeds about the size of children's marbles.—The small bonduc, *Guilandina bonducella*, grows to the height of only 8 or 10 feet; its leaves are smaller and more closely set than those of the greater bonduc; its flowers are of a deeper yellow; and its seeds are ash-coloured, very bitter, yet not unpleasant to the taste, and are used in India as a tonic, as a febrifuge, and for some other medicinal purposes.

BONDUC (HARDY), or KENTUCKY COFFEE-TREE, —botanically *Gymnocladus*. An ornamental deciduous tree, of the pea tribe. The Canadian hardy bonduc, *Gymnocladus canadensis*, is the only species of *gymnocladus* known; and it was formerly included in the genus *guilandina*. It was introduced to Britain in 1748, by the Duke of Argyle; but, though quite hardy, it seems never to have been yet cultivated in this country as a forest tree, or any where but in the garden. It grows wild on the banks of lakes Erie and Ontario, and in the states of Kentucky and Tennessee. It usually attains a height of only about 20 feet; but specimens were seen by Michaux of the height of 50 or 60 feet. Its stem is erect, firm, and comparatively very lofty before branching, yet seldom exceeds 12 or 15 inches in diameter; the bark of its stem is very rough, and becomes detached in small vertical stripes, but the bark of its branches is smooth, bluish, and ash-coloured; its leaves are doubly pinnate, three feet long, and 20 inches broad, and the folioles of them are large, smooth, entire, and ranged alternately on the midrib; its flowers have a white colour, and appear in July and August; and its seeds lie embedded in a pulp in one-celled legumes, but, notwithstanding their name of Kentucky coffee, do not seem to possess any culinary value. A full grown tree has a very fine appearance in summer. The duramen or heartwood constitutes a singularly large and profitable proportion of the stem; for, in a diameter of six inches, the alburnum constitutes only six lines. The timber has a rosy hue, is very compact, and seems well adapted for not a few purposes of the cabinet-maker. This tree may be propagated from either seeds or layers; but the seeds must be procured from America; and, when sown, they often lie two years be-

fore sending up the plumules of the young plants.

BONE. The different parts of the skeleton, or that solid framework which supports or protects the soft parts of the body of the higher orders of animals, are called bones; and owe their solidity to inorganic earthy materials which they contain. Bones are not equally compact throughout their whole substance, but exhibit on their surfaces an osseous mass of a denser nature, while their interior part forms a more or less cellular or spongy mass. The bones are covered both externally and internally by a membrane called periosteum, by which the ramifications of the blood-vessels and the nerves pass into them. This membrane is formed by a dense tissue which, by boiling with water, is converted into gelatin or glue. The long or cylindrical bones, such as those of the extremities, are hollow, and generally filled with marrow. The bones themselves consist of a living or organic portion, formed of cartilage; and an earthy or inorganic, formed mainly of phosphate of lime, with a certain portion of carbonate of lime. The cartilaginous portion of bone is formed before the deposition of the earthy takes place, and the ossification always starts from certain fixed points, called points of ossification. The mode of combination of the organic with the earthy matter is not well understood, but it is generally supposed to exist by the extremely small cavities of the former, receiving earthy particles in the same way that a sponge holds water.

The *organic* or *cartilaginous* portion of the bones may be obtained in a separate state by immersion of a bone in diluted muriatic acid at a temperature of 54° or less. The acid dissolves the earthy portion without attacking perceptibly the cartilaginous, which is then freed from remaining acid by repeated steepings in cold water, and remains in the original form of the bone, but transparent, flexible, and elastic. By drying, it shrivels up, and becomes hard and brittle, but remains translucent. It is entirely converted into gelatin by boiling in water, with the exception of a few fibres, derived from the fine blood-vessels, which remain insoluble and may be separated by filtration. If bones be treated by heat with dilute hydrochloric acid, a portion of the cartilage is dissolved, and a disengagement of carbonic acid is apparent, by which the bone, when half dissolved, begins to separate into fibrous longitudinal laminae, having the power, like mica, to polarize light.

The *earthy* or *inorganic* portion of bone consists mainly of phosphate and carbonate of lime in different relative proportions in different tribes of animals, and mixed with small and variable portions of phosphate of magnesia and fluoride of calcium.

The earthy portion of bone or *bone-ash* is easiest obtained by calcination of bones, but it then contains substances which do not exist in them ori-

ginally, such as sulphate of soda, formed from the sulphur in the cartilage, and also alkaline carbonates from the same source. The carbonate of lime of the bone loses also in this way most of its carbonic acid. The carbonic acid is combined in bones with the lime in the same proportion as in common carbonate of lime.

The composition of bone freed from periosteum and fat, and dried by heat till they lose no more in weight, will be seen from the following table.

	Bone of man.	Bone of oxen.
Cartilage,	32.17	33.30
Vessels,	1.13	
Basic phosphate of lime, with a small quantity of fluoride of calcium, . }	53.04	57.35
Carbonate of lime,	11.30	3.85
Phosphate of magnesia,	1.16	2.05
Soda with a little chloride of sodium, .	1.20	3.45
	100.00	100.00

Barras has determined the quantities of phosphate and carbonate of lime in the bone-earth of different animals in 100 parts.

	Phos. of lime.	Carb. lime.	Carb. lime to 100 of phosph.
Lion,	95.0	2.5	2.03
Sheep,	80.0	19.3	4.12
Chicken,	88.9	10.4	1.70
Frog,	95.2	2.4	5.76
Fishes,	91.9	5.3	2.52

The bones of fishes contain less bone-earth, in proportion to their amount of organic matter, and are generally more flexible.

	Chevreul, Cranium of eod.	Dumas, Bones of pike.
Animal matter,	43.94	37.36
Phosphate of lime,	47.96	55.26
Sulphate of lime,	—	—
Carbonate of lime,	5.50	6.16
Phosphate of magnesia,	2.00	—
Sulphate of soda,	—	—
Soda with chloride of sodium,	0.60	1.22
Fluor. calc., silica, alumina, oxide of iron, and loss, }	—	—
Fluor. calc. phos. of magnesia, and loss, .	—	—
	100.00	100.00

In cartilaginous fishes the skeleton consists of a peculiar animal matter, with no distinct bone-earth. The only chemical examination of this substance is by Chevreul, who examined the bones of *Squalus peregrinus*. This substance is translucent, of a bluish colour, flexible, very sectile, and may be cut into thin slices. In its chemical behaviour it resembles mucus more than any other substance. In warm water it swells up, becomes transparent and invisible, but it requires more than 1000 parts of boiling water for solution. The solution is not precipitated by an infusion of galls, and yields no jelly by evaporation. By long continued boiling, it is converted into a strongly gluing liquid, which does not gelatinize on cooling, but which is precipitated by a solution of tannin. In alcohol this substance shrivels up, while an oily fat is extracted. It is easily dissolved in acids, especially in chlorohydric, and the solution is coagulated by tannin. It would be interesting to know whether this substance do not form the cartilaginous portion of the bones of fishes properly so called.

Bones are of extensive use in the arts. In their natural state, or dyed of various colours, they are made into handles and numerous articles of turnery. Calcined bones are employed for the manufacture of phosphorus. By boiling in water, a fat may be extracted from fresh bones, and by Papin's digester their cartilaginous portion converted into a jelly, which, however, has not been found to answer the purpose of a wholesome sustenance. Bone-dust or ground bones are employed as a superior manure. The cartilaginous portion of bones is sometimes used for the manufacture of glue. See GELATIN.

BONE-BLACK. The black carbonaceous residue obtained by the dry distillation of bones, or by charring them by ignition in close vessels. This kind of animal charcoal is mainly used to deprive various solutions, as syrups, &c., of their colouring matters. Another less extensive use is as a black pigment. When prepared for this latter purpose, it generally receives the name of *ivory-black*, under which name pulverized bone-black is often sold in the shops. The antiputrescent and decolourizing properties of charcoal in general was first noticed by Lowitz. The first useful application of charcoal from wood to the purification of syrups was made by Guillon. In 1811, Figuier of Montpellier showed that animal charcoal surpassed greatly vegetable charcoal in its decolourizing power, and in 1812 it was employed by Derosnes for the purification of syrups, and sugar-refining. The manufacture of bone-black is performed by two different systems of apparatus. If the object be to condense and collect at the same time the volatile products which escape in charring bones, this process is formed in retorts similar to those employed for the distillation of coal in gas-works. When the operation is finished, the bones are raked out while hot into receivers, which are covered air-tight till they are cool, and the retorts are immediately charged again with fresh bones.

Where the object is merely the manufacture of bone-black, the charring is performed in cast-iron pots or cylinders, which are piled one on top of the other, the bottom of the upper one forming the cover of the next beneath it, the joints being luted with clay, and the uppermost pot being closed by a cover.

After the dried and broken bones are filled into the pots, and these placed in the kiln and the door shut, the firing must at first be moderate, but afterwards raised and maintained at a brisk heat for 5 to 8 hours. The door of the ash-pit and the damper may now be nearly closed to moderate the draught and keep up a steady ignition for 8 to 10 hours longer without additional firing, after which the doors must be all opened to cool the furnace. When this is done, the brickwork of the entrance door must be taken down, the kiln emptied and immediately filled again with a set of pots with fresh bones. The pots which have been ignited may in the course

of a short time be opened, and the contents put into the magazine. Before being ground, they must be assorted in order to remove those pieces which have been burned white. The bones lose, on the average, from 40 to 50 per cent. In reference to the quality as a decolourizing agent, experience has shown that it is so much more powerful, as the bones from which it has been made were previously freed from adhering fatty, fleshy, and tendinous matters. Before being put into commerce as bone-black, the ignited bones are broken up into a coarse powder by being passed between two iron cylinders and sifted through two sieves, one to remove the small dust, and one with large meshes to separate the proper sized grains from the coarser lumps. Sometimes it is ground to fine powder in a mill. The following is the average composition of common bone-black.

Phosphate and carbonate of lime,	88
Charcoal (nitrogenous),	10
Carburet or siliciuret of iron,	2
Sulphuret of calcium or iron,	trace

100

BONE-MANURE. Bones employed for fertilizing the soil. They have been applied in a very great variety of conditions and forms, raw and boiled, fresh and rotten, fermented and unfermented, whole, broken, bruised, and powdered, digested in powerful solvents or reagents, reduced to incineration, and mixed in several conditions with various diluents and composts.

Bone-manure began, long ago, to be used in the hothouses of Germany; it became slowly known as a fertilizer to the best informed class of English cultivators; it was at first tried, in this country, with hesitation, in obscurity, and under very bungling processes of management; and it eventually acquired the fame of being one of the most facile and powerful appliances for enriching the fields of our cold and humid climate. In some of the earliest farm applications of bone-manure in Great Britain, the bones were uniformly calcined or incinerated, and, in consequence, deprived of oil, gelatine, and other matters which constitute a considerable portion of their fertilizing power; and, in others, they were broken by the hammer, or reduced by lime, or decomposed by urine, or distributed along the bottom of the farm-yard heap, or otherwise so prepared as either to occasion loss of their own virtues or a wasteful expenditure of labour. But when better methods of preparation were devised and introduced to general practice, bones became suddenly recognised as both an economical and a most powerful manure; and they acquired a celebrity nearly as great, and not one-fourth so factitious, as that which has since been accorded to guano.

Bones have, for many years past, been imported in large quantities from all the principal ports of the north of Europe; and, for some time, though in smaller quantities, from the south of

Europe and even from South America. The only importations at first, and the principal importations for a considerable time afterward, were from Germany; and, when the bones from that country had brought the uplands of Nottinghamshire, the western parts of Holderness, and some other originally poor districts, into a state of high cultivation and fertility, a proverb arose, "that one ton of German bone-dust saves the importation of ten tons of German corn." As Malta formerly covered her naked rocks with soil from foreign lands, so England fertilized her barren clays and sandy heaths with bones from Germany. Most of the imported bones have never been boiled; a large proportion appear to have been buried in the earth or in composts till the soft parts have become detached; and some seem to have belonged to carcasses whose fleshy portions have decayed in the open air. The bones from some of the seaboard districts of Germany are partly the exhumations of burying-grounds,—the robbery of the repositories of the human dead being ironically excused by its rendering the bone trade popular; those from some other parts of Germany have been deprived of their gelatine, and appear to have been boiled for glue,—but these, though easily bruised and rapid in their action, are not much esteemed; those from Russia are reduced to a somewhat bruised state, partly that they may occupy less room in stowage, and partly that they may comport with a Russian law which forbids their exportation unless they be more or less manufactured; those from the south of Europe are drier, more brittle, more reducible to fine powder, and capable of a more uniform distribution in the soil than those from the north, but at the same time more rapid in their action and less durable in their power; and those which are collected in our own large towns are, in all respects, the best which can be obtained, but are far too meagre in quantity to meet more than a small fractional portion of the existing demand. In a report on agricultural produce and shipping, which was printed by order of the House of Commons in February 1842, statistics are given of eleven ports of the northern countries of Continental Europe; and two of these ports were found to export no bone-manure to Great Britain, Hamburg made exportations to a large but unascertained amount, and Rotterdam, Bremen, Lubeck, Kiel, Rostock, Stettin, Elsinore, and Dantzic, annually exported, in the aggregate, 13,084 tons.

"Bone-dust," said Mr. Shier in 1844, "is much used all over Scotland, but in no district so universally as in Aberdeenshire and the adjoining counties, where it is for the most part applied in supplement to farm-yard manure in growing turnips. During the year from 1st June 1840 to 1st June 1841, there were imported into Aberdeen from foreign ports 4,355½ tons, and on the average of the last six years, 3,461 tons annually.

The best bone-dust is found to weigh 54 lbs. per bushel; and reckoning 20 bushels of such dust a sufficient dose for an imperial acre of turnips, the average quantity imported into Aberdeen should dress 7,178½ acres; and that not merely for the green crop, but for the whole of the usual five or six course rotations. And used in supplement to a dose of 10 tons of farm-yard manure, the more common and certainly more profitable way of using it, on open soils, the 3,461 tons would suffice for from 14,356 to 17,946 acres."

Almost every seaport of any consequence on the east coast of Great Britain has one or more mills for crushing bones into a condition to be used as manure, and annually imports a number of cargoes from continental Europe. Yet Hull excels all the others in this traffic; and sometimes has in its docks, at one moment, not fewer than thirty or forty cargoes of bones,—all destined to be crushed in and around the town, and a considerable proportion to be sent up the inland navigations of the Humber for dispersion through the interior of the country. In 1823, the declared value of the bones imported into Great Britain was only £14,395; in 1837, it was £254,600; and, since the latter date, the quantity must have very greatly increased. In 1815, the quantity imported into Hull was about 8,000 tons; in 1833, it was 17,500 tons; and, in 1835, it was 25,700 tons. Most are ordered from commercial houses in Hamburgh, who have ramifications in all the western seaports of the continent; and the greater part are brought to Britain in vessels belonging to the Netherlands, to the free towns of Germany, to Denmark, and to the Baltic.

Bones are carefully collected in both town and country throughout Great Britain. Every well conducted farmstead has a large old cask or some other suitable receptacle for them, situated in some such place as the inner court of the cartshed, and protected by a cover from the aggressions of dogs, cats, and rats. In large towns, numbers of very poor persons earn a miserable livelihood by collecting them from every mass of rubbish or ashes where they are possibly to be found; and, in London, the bone-boilers daily send around spring-carts to collect them from shambles, inns, eating-houses, and all similar places. When a bone-boiler has a bone-mill, he first sends them through his coarsest breaking cylinders, and then puts them into boilers; and when he has not a bone-mill, he employs men to chop them into small pieces with short-handled axes, and then to pitch them into the boilers. When the bones are well-boiled, the fat is skimmed off,—the finer portion to be used in the manufacture of soap, and the coarser portion for coach and cart grease; and when no more fat can be obtained, they are stacked up in the yard, either to be crushed on the same establishment, or to be sold to the bone-crushers of the ports along the east coast.

Boiled bones are freed, by the process of boiling, from all greasy, fleshy, and fibrous matter; and they may, in consequence, be reduced to a state of comparatively fine powder. "I find," says Mr. Halkett of New Scone, "that numbers of agriculturists, and even scientific men, who have analyzed bones, are of opinion that the marrow and fatty matter in them are of great use in their operation as a manure; and I must confess that at one time I was led to believe, from its plausibility, and what I thought a common sense view of it, that this was the case. But now, after the test of experience, by numerous trials, between what we call green bones with all the marrow and fat in them, and dry ones free from it, I have always found that the latter raised by far the best crops. Therefore, I have arrived at the conclusion, that the less animal fat in them the better, and that the boiling of them before crushing, instead of injuring them, is a benefit." A report on bone-manure by the Doncaster Agricultural Association corroborates Mr. Halkett's observation, and states that bones in their green state were found to be less effective fertilizers than bones which had passed through the manufactories. General experience, too, seems not to have detected, at all events has not established, any difference between the value of the two kinds; for, in the great majority of instances, the same price is paid for both to the bone-crushers. Yet both scientific principles and careful persevering observations dissent from these conclusions, and affirm that bones which have not been deprived of their fat and gelatine, though probably not so rapid in their action or aggregately so efficient upon turnips as boiled bones, have both a more durable and a more powerful influence upon the soil, and yield considerably richer results throughout the cumulative produce of the rotation.

All "green" bones, and such boiled ones as are not intended to be completely pulverized, are crushed or brought into a suitable mechanical condition for application to the soil, by being passed through toothed cylinders, of one, two, or three pairs; and in the case of the green bones, a set of malleable iron scrapers is attached to the lower part of the cylinders, in order to clear away adhering animal matter from the teeth. Small machines with two cast-iron toothed cylinders, for breaking bones into sufficiently small pieces, have been erected on some large farms; yet, except in rare cases, the crushing of bones is a distinct occupation, conducted upon an extensive scale, and effected in comparatively large and powerful mills. Mr. James Anderson of Dundee, about seventeen years ago, erected a singularly excellent bone-mill, worked by a twelve-horse-power steam-engine, for the supply of the districts around Dundee; and he sent an elegant metal model of it to the Museum of the Highland Society, and received from that institution a premium in approbation of both his own exertions and the construction of his machine. The bones

to be ground in Mr. Anderson's mill are conveyed from the mill-floor to the upper part of the machinery, by a series of buckets, attached to a double chain. They are discharged upon a sheet of canvass, extending over two revolving rollers, by the motion of which they are conveyed to two cast-iron rollers, to which are fixed concentric rings of malleable iron, with teeth, so as to present a serrated edge. The bones are thus partially bruised, and fall down upon a similar pair of rollers, but with the rings and teeth more closely set. Immediately underneath this second pair of rollers, is a riddle, kept in motion by a crank. The bones which have been completely ground fall through the riddle, and are received into a small division or apartment beneath. The rougher bones, or those which are only partially ground, and have not fallen through, are conveyed by the motion of the riddle to a third pair of rollers formed like those above, but with their rings and teeth still more close. Immediately underneath these last rollers, is placed a second riddle, kept in motion like the other, through which the bone-dust falls directly into the division below formed to receive it, while any of the bones not sufficiently ground to pass through the riddle are carried forward by its motion into another apartment or division, from which they are either taken to be sold in their rough state, or are conveyed up by the buckets as before, to pass again through the machinery. A paper in the portion of the Highland Society's Transactions published in August 1829, whence we have borrowed our notice of this bone-mill, contains both vertical and front views of it, and a detailed technical description.

In some districts, the bones are crushed into the four different conditions designated, in reference to the size of the largest pieces, inch, three-quarters-inch, half-inch, and dust,—the last being in a great measure collected by riddling the inch and the three-quarters-inch; in other districts, as in Yorkshire, they are crushed into the three conditions of inch, half-inch, and quarter-inch or dust; and in others, as in Perthshire, they are crushed into only the two conditions of half-inch and dust. In the first of these methods, the inch and the three-quarters-inch kinds consist almost wholly of pieces from the maximum size of the designation down to about a quarter of an inch; the dust consists of a mixture of large grits and fine powder; and the half-inch consists of a mixture of powder, grit, and pieces to the maximum size of the designation, and is generally and most justly regarded as considerably superior to any of the other varieties. In the second or Yorkshire method, the dust consists of everything which passes through a sieve of little more than a quarter of an inch in calibre; it contains all the sand and earthy matters accidentally lodged in the hollow of the bones, all the carious and rotten portions of the bones, and all the very old or partially decayed bones which are reduced to powder

by the first touch of the cylinders; it is much inferior in quality to the inch and the half-inch varieties, and acts for a much shorter period in the soil than they; yet it is heavier, comprises a much larger quantity of matter in a bushel, and will spread over a larger superficies of land; and it acts more rapidly in pushing up turnips to a braird, and therefore operates, to a certain degree, as a preventive against the ravages or even the attacks of the turnip-fly. The half-inch variety, as prepared in the Yorkshire method, is free from the impurities of the more pulverized variety, and, when made from good bones, is, in most respects, superior; yet when sown unmixed, it passes slowly into decomposition, and is tardy in pushing turnips to the braird. Whenever bones are crushed in the Yorkshire method, they will act most advantageously if the half-inch variety and the small variety be mixed in equal portions,—the latter to braird the turnips, and the former to operate durably in the soil. But the Yorkshire crushers mix them only when specially ordered to do so; and then they measure the two kinds separately, and, in consequence, give, in point of fact, little more than two bushels under name of three,—the powder of the small variety disposing itself in the interstices of the other variety.

Bones from various parts of the continent, but principally from those places whence they have been longest and most bulkily imported, are frequently so much adulterated with stones, hoofs, horns, and every kind of cheap or waste matter which will add to their weight, that they require to be handpicked before they can, with safety to the teeth of the cylinders, be subjected to the process of crushing. But a vastly more mischievous adulteration is extensively practised by the crushers themselves,—one which not only indemnifies them for the loss by foreign adulterations, but which sometimes imposes to a grievous extent upon farmers, and indirectly occasions a serious paucity of crops. Some farmers, too, have an extreme fondness for finely pulverized bone-dust, and blindly afford the utmost facility for the practice of the adulteration. One ingredient very extensively used, more extensively perhaps than any other, is the refuse lime of tan-works, after it has been employed in removing wool and hair from skins. This is passed, in clotted lumps, into the cylinders of the bone-mill; it is freed from wool and hair, and mixed with a proportion of bone-dust; and it appears very small, has a very pungent smell, and readily commends itself to the unwary as prime bone-dust. "I am aware," observes Mr. Halkett, "that this mixture has often raised a good crop of turnips in damp seasons. I have likewise known it destroy the seed entirely, when good bones beside it did well. I have no objection that it should be used as a manure for turnips; but why call it bone-dust, and not sell it for what it is? I once saw it used by itself, without any admixture of bone-dust."

and it proved an utter failure; and I am led to believe that it is the small quantity of bones in it that sometimes raises the crop without any assistance from the lime whatever." Old mortar or plaster lime is also used; but it is inodorous and absolutely useless; and should it happen to be not thoroughly pulverized, it may easily be detected by its admixture of hair. Soap-boiler's waste is likewise employed; and it is powdery, of a bluish-white colour, and probably acts no otherwise on the soil than by imparting a slight degree of alkaline matter. The refuse of bone-dust from the manufacture of sal-ammoniac is also occasionally employed; and, like the refuse lime of tanneries, it has pungent properties, and is apt, in some seasons, to burn the seed. Saw-dust, slaked lime, rotten wood, and various other ingredients are used; but, in general, are more easily detected than those already named. Every purchaser of crushed bones, and especially of bone-dust, who has not an opportunity of watching the process of manufacture, ought to make a thorough examination of any quantity submitted to his inspection.

Bone-manure has been applied, with great success, as a top-dressing for grass lands. In this case, it must be sown by the hand broadcast, in the same manner as corn; and either applied in the state of powder if the land is soon to be subjected to the scythe, or applied in pieces of the maximum size of a walnut if sufficient time is to be allowed for crumbling down by decomposition. It suits ill upon clover of the first year, or even upon grass of not more than the third year after tillage; and, when applied to old grass lands, it must be used in a considerably larger proportion than is suitable for tillage cropping. Upwards of 600 acres of pasture land upon one estate in Cheshire have, within the last thirteen years, been raised, by the application of bone-manure, from a value of from 10s. to 15s. to a value of from 30s. to 40s. The cost of the application has been about £10 per acre; and 7 per cent. of it is added to the rent payable by the tenants. The manure is applied in pieces about the size of walnuts, in quantities of from 30 to 35 cwt. per acre, and never upon land which has been in grass for a less period than seven years. It is most successful on old sour sward with a clay subsoil; it never fails upon any strong sward which is free from surface water; and it is also advantageous, though not to the same degree or with the same unfailing uniformity, upon dry friable pasture with a sandy substratum. "The end of April," says the reporter of the Cheshire case, "I consider the best time to apply bones: no stock ought to be put upon the land before the following spring. If the land is not too poor to produce a crop of hay, I do not object to its being mown the first year, but on no account afterwards. It is now twenty years since I first saw bone-dust applied to pasture land, on a field adjoining Lord Combermere's estate. At the time the bones were put upon the

land, it certainly was not worth more than 10s. an acre; and though so long a period has elapsed since the field was manured with bones, it is now worth 35s. an acre, though I think the land is not quite so good as it was five years ago. I consider bones the cheapest of all manure for mowing-grounds. Eight years ago, I manured part of one of my mowing-fields with bones, 35 cwt. to the acre; the land has produced me a good crop of hay every year since, quite equal to the other part of the field, which had been manured with good farm-yard dung every two years. Once in eight or nine years is quite enough to manure mowing-lands with bones; and I am quite certain that pasture land on which bones have been applied never will (so long as it remains in grass) return to the state it was in before the bones were put on." As a general rule, bone-manure is best applied to dry pasture, whether natural or artificial, in spring; but to meadow land, the growth of which has been fed off, it is best applied at the earliest possible moment after the cattle are removed. Yet this rule is subject to exceptions, occasioned by the state of the land and the character of the season; for if the meadow land be wet, either habitually or from the unusual prevalence of rains, the application of the manure to it ought to be postponed till the ground becomes dry and the weather warm.

Bone-manure has been variously applied, with great success, as a preparation for wheat and other tillage crops; but, by universal observation, it is found to operate with the most eminent advantage, as to both its immediate and its more remote effects, when used for turnips at the commencement of a rotation. It is sometimes spread broadcast, but is much more generally drilled in with a machine. When spread broadcast, if it be in a state of decay or of complete readiness for operating on the soil, it is, in very many instances, harrowed in with the last ploughing or immediately previous to the sowing; but, if in a fresh state, without having been boiled or fermented, it ought to be allowed to lie a sufficient time upon the surface of the ground, to subject it to incipient decomposition, and fit it for developing its powers upon the nascent crop. Some very intelligent farmers prefer the broadcast method for the reasons, that the turnip plants receive much more nourishment through the side-radicles than through the tap-root, and will therefore be better fed by broadcast than by drilled bone-manure,—that a serious difficulty exists in mixing drilled manure with the soil by after-ploughing,—and that, although this difficulty is lessened by cross-ploughing the ridges, yet the stripes of land between the drills never receive their due proportion of benefit. A medium method is practised by some farmers, of first sowing the manure broadcast, and then gathering it into ridges with the mould-plough. But general experience, based on thousands or even myriads of experiments in all the best farming districts of Great Britain,

gives decided preference to the drill method,—and this, whether the bone-manure be used alone, or in combination or accompaniment with other materials.

The usual manner of dropping bone-manure in drills, is either simultaneously with the turnip seed, by means of a machine for the purpose, attached to the turnip sowing-machine, or in depositions separately made from the seed, by means of a machine wholly employed for itself. Models of five machines for the former of these methods, and of one for the latter, may be seen in the museum of the Highland Society; and are described, in language which we shall quote, in the descriptive catalogue of the museum. One of the turnip and bone-dust sowing-machines is adapted for sowing two drills, with a simultaneous deposit of the seed and the manure. "It is mounted on two wheels, which serve to turn both the seed and the bone-dust apparatus. The former consists of the common tin seed-barrels; the latter, of two wooden hoppers to contain the bones, and carrying in their bottom each a wide-toothed or notched wheel, which, by its revolution, discharges the bones into a tube which terminates, in common with the seed-tube, in the chamber of the coulter. The discharge of the bones is regulated by a slider which enlarges or diminishes the passage from the hoppers. The machine is drawn by one horse; and the distance between the coulters is regulated by hand-gear." Another turnip and bone-dust sowing-machine was invented by Mr. Nicol of Guildy in Forfarshire, and bears date 1830, but ranks merely as one of the early combinations of the machinery for simultaneously depositing the seed and the manure. "The principles of this machine," says the Catalogue, "are much like those of the former; though the arrangement of the parts and modes of communicating the motions are somewhat different. The machine moves on one large roller, and a fore-wheel without a swivel-bar; the former gives motion to the sowing-gear; and the adjustment of the coulters is effected by hand-gear not self-acting." A third turnip and bone-dust machine bears the date of 1830, and was invented by Mr. Hamilton of Dumfries-shire; but it merely possesses the same properties as the preceding, with some differences of arrangement. A fourth and quite different turnip and bone-dust machine bears the date of 1835, and was invented by Mr. Liston of Blairgowrie. "In this sowing-machine, a new system of depositing the seed and manure was attempted. Instead of sowing continuously, this machine was intended to deposit a portion of seed and manure together, at stated intervals, whereby a saving might accrue, both in the seed and manure, and the first thinning of the braird might be dispensed with. The construction of the machine differs both from previous turnip and bone-dust sowers, except in the depositors; these consist of a short double conical roller, which forms the groove or rut, in

a continuous form, for the reception of the seed and manure, and this followed by a short cylinder, partly incased in a cover. The cylinder is chambered on the periphery; in these, certain quantities of the seed and manure are collected; and as the cylinder revolves, and the machine progresses, these little collections are discharged at the proposed distances. In practice, however, it was found that the chambered cylinder did not deliver its contents at intervals, but nearly uniform, except when the machine travelled so slow as to be ineffective." The fifth turnip and bone-dust sowing-machine bears date 1840, is the invention of Mr. Nicol of Guildy, and was intended as an improvement on Mr. Liston's, escaping its faults, and achieving its proposed purposes. "Its construction is nearly the same as the last described, except the dropping apparatus. This consists of a raised fillet encircling the front rollers, and having also obtuse dibbles proceeding from it at nine-inch spaces, which, while the roller levels the top of the drill, forms also a smooth channel, with dibble-holes at nine inches apart, along its surface. Into this channel, the seed and bones are deposited continuously; but an iron instrument or scraper follows close behind, having a protuberance that follows in the channel of the drill; this member sweeps the bones and seed before it till they fall into the first dibble-hole, and so on." The last bone-sowing machine which we require to notice, is that which deposits the bone-manure alone, or without the seed. "This machine is employed for depositing bone-dust or other granulated manures in drills, and is adapted to serve three drills at each turn. The bone-chest is mounted on two wheels, one of which gives motion to the three distributing wheels placed inside the chest; the revolutions of the latter give out the manure to the sheet-iron tunnels, which deliver it into the furrows previously prepared by the plough. The quantity to be discharged is regulated by sliders which lie over the orifices. In depositing manure by this machine, it is laid in the furrows between the first-formed drills, and is then covered up by passing the plough along the drill and cleaving it. After this operation, the seed is deposited by the common turnip sowing-machine. The bone-sower may be drawn by one horse." All these machines, however, are so costly that any occupier of a small farm cannot prudently purchase them, and can seldom obtain an occasional use of them except at an unreasonable hire.

The quantity of bone-manure suitable for an acre of tillage land varies according to the condition of the manure, the character of the soil, and the nature of the crop; yet it usually has certain limits of utility, or limits beyond which all applications of it are wholly wasteful. It has sometimes been applied to the extent of 100 bushels per acre, and often, for the sake of experiment, to the extent of forty or fifty bushels; but, in all

such cases, it is, in a great degree, prodigally wasted. The average quantity of all conditions, stated in the report of the Doncaster Association, is 39 bushels; and the quantity of the powdered varieties, as there stated, ranges from a little less than 20 bushels to something upwards of 30. But the most approved practices in England appear to give from 25 to 30 bushels of half-inch bones, and about 20 bushels of bone-dust. In general, about 25 bushels of any medium variety is quite sufficient for producing a good crop of turnips, and exerting a fertilizing power over a subsequent rotation, on poor light sandy soil; and any quantity above this which may, in any case, be thought desirable, ought to be applied at some future period, as a preparation for some white crop of the series. But, says a writer in Vol. ix. p. 103 of the Quarterly Journal of Agriculture, "we have universally in Scotland a notion that the half, at least, of the turnips raised by means of bone-dust ought to be eaten off by sheep; for, without such assistance from other manure, we conceive the bone-dust would have too much to do of itself in supporting all the crops during the rotation. This being the notion in Scotland, the practice originating from it is, that never more than sixteen bushels generally, though some farmers apply twenty bushels, is applied to the imperial acre. We have also a notion in Scotland, that bone-dust has a caustic quality, and that considerably more than sixteen bushels to the acre on light soils, would do more harm than good. We have ourselves experimentally tried the effects of different quantities of bone-dust in raising turnips on light gravelly soil, from twelve to twenty-five bushels per imperial acre, and found the crop improve decidedly to sixteen bushels, but not in the least beyond that quantity. So far, therefore, as the turnip crop was concerned, any quantity above the sixteen bushels was thrown away." "Bones," says the Rev. Mr. Rham, "have been drilled with wheat at the rate of 30 bushels of bones and $2\frac{1}{2}$ of wheat per acre, and a good crop (twenty-four bushels per acre) has been obtained on very poor soil; while portions of the same field sown without any bones, in order to ascertain the effect, did not produce sufficient plants to cover the ground or return the seed."

A wide difference, or rather a complete contrast, of opinion exists among farmers as to whether newly-crushed or old-crushed bone-manure be the best; some asserting that they never have good turnips except from newly-crushed bone-dust, and others, that the best turnips they ever had were from old bone-dust. "Both instances," remarks Mr. Halkett, "may be true; but at the same time it may also be true, that both, from season and management, may have the best crop of turnips they ever had, with the worst bone-dust they ever used." We must look beyond the conflict of practical opinion to one or two unquestionable facts respecting the manure

itself, in order to know the relative value of the old and the new. All newly-crushed bone-manure, however dry, heats and ferments with a rapidity and a violence proportioned to the degree of moisture and of heat in the heap; and in general, it rises in temperature and in fermenting action till about the fifth or the eighth day, and then slowly subsides into a cool and quiescent condition; and in the process of cooling—in consequence partly of evaporation, but chiefly of becoming more friable and so losing its sharp points as to lie more closely together—it suffers a diminution of bulk which, though not observable by the unpractised eye, can very readily be detected by re-measuring. If a parcel of bones, amounting to 1,000 bushels, be crushed in February, and not sold till the middle of May, it will then measure only about 960 bushels; and while a bushel of it when it was newly crushed would weigh only 47 pounds, a bushel of it in the middle of May will weigh 49 pounds. The purchaser of old bone-dust, therefore, unless he pay a proportionally higher per centage for it, obtains more material for his money than the purchaser of newly-crushed bone-dust. The only intrinsic difference between the two varieties, also, seems to be in favour of the old dust for turnips or for any other purpose which requires speedy evolution of the manurial power; for the effect of the fermentation is simply to induce nascent decomposition, or to bring the bone-dust into quite or very nearly the same state as if it had lain for a short period in the soil.

Old bone-dust remaining unsold at the close of the turnip-sowing season, may sometimes be obtained at a somewhat reduced price; and, when purchased by a farmer, requires a little peculiar treatment for its proper conservation, till the next season. If it has been crushed in a previous year, and more than once heated, it possesses either a bluish or a yellow tint; and when examined through a microscope, will be found full of small mites. When either this decomposing bone-dust, or even comparatively fresh dust of the season, is purchased by a farmer, it ought to be laid on a dry floor, in a cool place, as completely removed as possible from all access of damp vapour. In consequence of the re-arrangement of its particles and the admission of air into its mass, it will heat after being removed to its new place of storage, though not to the same degree as on the first occasion; and for the same reasons, it will heat again on every occasion of its being turned or much disturbed. When spread thin on the floor, it will not heat so much as when spread thick; but, in almost every instance, it will send off so much putrescent vapour as to rot a wooden floor above it, and damage the boarded floor on which it lies. It ought never to be kept in bags, for it will speedily destroy them, nor in the vicinity of horses or cattle, for it will provoke them to restiveness, and perhaps incite disease by its disgustingly foetid odour.

When a soil is of a very decidedly open texture, bone-dust ought to be applied to it only in accompaniment with farm-yard manure,—the latter being first spread in the drills, and then the bone-dust sown over it, before covering in with the plough. This accompaniment of farm-yard manure with bone-dust is peculiarly suitable for dry seasons and early sown turnips. A good proportion of the two manures, in ordinary cases, is from 8 to 10 bushels of the bone-dust, and about 10 tons of the farm-yard manure.—But another and more common method of jointly applying the two is previously to mix them, to induce nascent decomposition of the bones, and to commingle all the ingredients of the farm-yard manure with them into a compost. The proportions in which they may be mixed, for this mode of application, is either about 50 bushels of bones and 4 or 5 tons of farm-yard dung, or about 20 bushels of bones and 4 or 5 tons of dung, or about 12 bushels of bones and about 8 tons of dung. The bones, when mixed in any of these proportions, or in any intermediate ones, and thrown together with the dung in a well-covered heap, will very rapidly undergo decomposition. One farmer states, “that he has used as much as 35 bushels of bone-dust, per acre, without manure, in the same field where he laid six loads of fold manure and ten bushels of bone-dust; but the turnips on the part manured with bone-dust alone were not so good as those on the part manured with the compost, and the succeeding crops were still worse in comparison.”

A frequent and usually advantageous method, for soils of a less light and open kind than those for which the commixation of bone-dust and farm-yard manure is suitable, is to work the bone-manure into a compost or mixture with ashes, loams, clays, or decayed vegetable matters, according to the particular character of individual soils, with clay for sandy soils, with ashes for clayey soils, and with loam or decayed vegetable for soils of medium porosity. Many intelligent farmers have reported, as the result of their own experience, that bone composts of these various kinds have acted more beneficially than bones alone; yet they do not seem, in general, to have adverted to the fact that such composts are valuable chiefly if not solely in the case of ‘green’ or unboiled bones, and that the rationale of their superiority consists in their solvent action upon the gelatine and the fat. Some farmers give to each acre a compost of 50 bushels of bone-dust and 5 loads of burnt clay or of good earth, and, by applying it broadcast and ploughing it in, have found it increasing the value twenty per cent. of all the crops of a rotation excepting clover. Other farmers apply to each acre a compost of 40 bushels of two-inch or three-inch bones, 5 loads of farm-yard manure, and a considerable but indefinite quantity of earth, and have observed a very visible effect from it upon the wheat crop at the end of a four-

year rotation. Other farmers use a compost of bone-dust, rape-dust, soot, farm-yard manure, and the ashes of weeds or of house fires, and find it eliminating a vast heat and undergoing a proportionately active fermentation. Mr. Shier recommends, as the best method of application to meadow or old pasture, such a compost of bone-dust, urine, and earth, that 8 or 10 bushels of bone-dust shall be given to each acre.

A writer in the *Quarterly Journal of Agriculture* of March 1833 asserts, as a result of his own experience, that about one-half of the usual quantity of bone-dust is efficient for the turnip-crop, when prepared into a compost with common coal-ashes. He says, “The quantity of bone-dust usually applied is two quarters per imperial acre: I use only one quarter per acre, but I always mix the bones with coal-ashes. These ashes may be procured in towns and villages, at a price not exceeding 5s. per ton; and the quantity mixed with the bones depends in a great measure on the quantity of ashes that can be obtained; the more of course the better, but it should never be less than one or two quarters per acre. The ashes are put in a dry place, under cover, such as a cart-shed or an out-house, and riddled as small as bone-dust itself. That which passes through the riddle ought only to be mixed with the bones. The bones should be very carefully and equally mixed through the mass, which will be best effected by frequent turnings with the shovel. The turnings also assist in drying the ashes, which, if they are not, they will not pass easily through the hopper of the sowing-machine. The ashes should be collected as early in the season as possible, that they may get thoroughly dried. After the bones are mixed with the ashes, the mass ferments, and evolves a considerable degree of heat, which subsiding, assists the drying of the ashes considerably. To expedite the drying of the ashes, when they cannot be procured early enough in the season, I would recommend their being strewed with a dusting of hot lime, while the mass is turning over, in the same manner that pickled wheat is dried with lime to render it fit for sowing. I never tried this expedient, because I always procured an early supply of ashes; but I feel confident it will answer the purpose. The compost is sown with the usual machine. Turnips raised with this compost of bone-dust and coal-ashes, in the quantity alluded to, I have sold for £7 per acre, to be eaten off with sheep; and they always possessed the same characters of a close crop, firm root, and hardness to resist the rigours of winter, that turnips raised with bone-dust alone evince.”

A method of treating bone-manure with sulphuric acid before applying it to the soil, has recently come into extensive use, and seems, from many experiments and concurrent observation, to be superior to all the older methods. It was originally designed merely to reduce the bone-manure to a state of fine powder, to occasion it

to mix more intimately with the soil, and to increase its readiness or aptitude for assimilation; but it has been found, by subsequent improvements upon it, to accomplish also the other and broader purposes peculiar to bone-manure. Dr. Liebig, who suggested this new practice, says, "The most easy and practical method of effecting their division is to pour over the bones, in a state of fine powder, half their weight of sulphuric acid diluted with three or four parts of water, and, after they have been digested for some time, to add about one hundred parts of water, and to sprinkle this acid mixture (phosphates of lime and magnesia) before the plough. In a few seconds, the free acids unite with the bases contained in the earth, and a neutral salt is formed in a state of very fine division. Experiments instituted on a soil formed from grauwacke, for the purpose of ascertaining the action of the manure thus prepared, have distinctly shown that neither corn nor kitchen-garden plants suffer injurious effects in consequence, but that, on the contrary, they thrive with much more vigour."—In a comparative experiment, made in 1843, on the home-farm of Gordon-castle in Morayshire, one acre was manured with 8 bushels of bone-dust and 14 yards of farm-yard dung; one, with 315 lbs. of guano; one, with 16 bushels of bone-dust; one, with 2 bushels of bone-dust, dissolved in 83 lbs. of sulphuric acid, previously diluted with 12 gallons of water,—the mixture allowed to remain between two and three days in a tub, and then diluted with 368 gallons of water, and applied to the drills by means of a water-cart; and one, with 8 bushels of bone-dust, mixed with 83 lbs. of sulphuric acid, previously diluted with 12 gallons of water,—and the mixture, nearly in a dry state, sown by hand along the drills. The soil on which the experiment was made was poor, light, and sandy; the turnips, raised immediately upon the manures, were Dale's hybrid, sown in drills 27 inches apart, and the one-half drawn for cattle in the yards, the other half eaten on the ground by sheep; the land was afterwards, without any manure, sown down with barley and grass seeds. After, in each case, deducting the cost of manure, the total value of the turnips and barley crops, was, on the bone-dust and farm-yard dung, £5 18s. 1½d.; on the guano, £5 17s. 9½d.; on the bone-dust alone, £6 4s. 11d.; on the liquid application of bone-dust and diluted sulphuric acid, £7 10s. 1½d.; and on the powdery application of bone-dust and diluted sulphuric acid, £6 16s. 9d.—Another comparative experiment, of an interesting character, and exhibiting still more decisive results in favour of the preparation of bones with sulphuric acid, was made, in the same year, on Lindor's farm, St. Briavel's, in Gloucestershire. The scene of this experiment was a worn-out arable field of sandy soil; the sowing was in the beginning of August with improved stone turnips, in lots of a quarter of an

acre; the ground was ridged up at 24 inches, the seed drilled on the ridge, and hoed out to 8 inches; the turnips were horse-hoed three times, and hand-hoed twice; and one perch of each lot was pulled, topped, and weighed on 8th January, 1844. One lot was manured with 15 yards of fat rotten pig's dung, cost £3 for manure, and produced 15 tons 2 cwt. 3 qrs. of turnips; another was manured with 3½ bushels of bone-dust and 80 lbs. of sulphuric acid, cost £1 6d. for manure, and produced 13 tons 1 cwt. 1 qr.; another was manured with 40 bushels of coal-ashes, which were saturated in the winter of 1842–3 with human urine, cost £1 3s. for manure, and produced 12 tons 12 cwt. 3 qrs.; another was manured with 20 cubic yards of road-scrappings, mixed with 280 gallons of human urine, and twice turned over in 1842, cost £2 3s. 6d. for manure, and produced 10 tons 12 cwt. 2 qrs.; another was manured with 2 cwt. of guano, mixed with 12 bushels of pure charcoal dust, cost £2 1s. for manure, and produced 10 tons 5 cwt. 3 qrs.; another was manured with 7 cwt. of urate, cost £2 1s. 6d. for manure, and produced 9 tons 11 cwt. 2 qrs.; another was manured with 20 bushels of bones, half dust, cost £2 14s. for manure, and produced 9 tons 1 cwt.; another was manured with 6 bushels of bone-dust and 20 bushels of charcoal dust, cost £1 13s. for manure, and produced 8 tons 17 cwt.; another was manured with 16 bushels of bones, half dust, cost £2 4s. for manure, and produced 8 tons 2 cwt. 3 qrs.; another was manured with 15 yards of half-rotten common straw dung, cost £1 10s. for manure, and produced 6 tons 13 cwt. 1 qr.; and another received no manure whatever, and produced 1 ton 10 cwt. 2 qrs. Mr. Purchas, who reports this experiment in the Journal of the Royal Agricultural Society, mentions that the accidents of the weather were peculiarly unfavourable to the full play of the preparation of bone-dust with sulphuric acid, and states "that perhaps half the quantity will be sufficient, and that the great chemist Liebig, to whom we are indebted for this valuable discovery, is right when he says that a much smaller quantity of bones and acid (viz., 40 lbs. fine bone-dust and 20 lbs. sulphuric acid per acre) will produce a good crop of turnips."

Several inconveniences, involving both risk and cost, occur in the method of preparing bone-dust with sulphuric acid as recommended by Dr. Liebig, and practised in the Gordon-Castle experiment. The carriage of the sulphuric acid from the manufactory or the market town, is hazardous, and may be expensive; the process of mixation with sulphuric acid upon the farm, may inflict very serious accidents upon persons so unacquainted with the tremendously acrid powers of that acid as almost all farm-servants are; suitable vessels for making the preparation either do not exist upon a farm, or can be purchased only at a considerable cost, and are useless for almost

any other purpose ; and the distribution upon land of so voluminous a quantity of liquid as 26 cwt. of dilution for every 58 lbs. of bone-dust, cannot be effected at any time without much trouble, and may, at the busy season of turnip-sowing, occasion serious derangement of the routine business of the farm. "From experience of these difficulties," says Mr. Shier, "I was led some years ago to try a dry preparation of bone-dust with sulphuric acid ; and this dry preparation has been found to combine so many advantages, that it is now very generally adopted in the county of Aberdeen. For making this preparation, the finest bone-dust is employed. Dust prepared from bones from the north of Europe may be got, by sifting, of the weight of 58 lbs. per bushel ; but as the dry bones from the south readily yield it of the weight of 75 lbs., the latter is of course to be preferred. Any convenient quantity of dust is laid in an oblong heap on a flagstone floor, a depression is made in the top of the heap, and one-fourth part of its weight of concentrated sulphuric acid is added in small quantities at a time, the mass being thoroughly turned and mixed, by means of wooden shovels, after each addition of acid. Alternately with each portion of acid, as much water is added. When the whole acid and water have been added, and the mixture is completed, the mass is hot and somewhat moist ; after lying in the heap for a day or two, it becomes quite dry, and is fit for sowing, either by hand or machine. The quantity of sulphuric acid in this mixture is but half that used in the liquid way, but it has been ascertained by many trials, that any increase above the quantity recommended is not so economical ; and indeed where, as occasionally happens, sifted bone-dust cannot be obtained, a farther diminution may be made with advantage. Concentrated sulphuric acid has been specified, but in places where only unconcentrated acid is made, it is cheaper to use that, a proportionally greater weight being employed. The value of the acid is of course determined by the hydrometer ; and it should be of the kind made from sulphur, and not from pyrites, as the latter generally contains a large quantity of arsenic. Although of this dry preparation a larger dose is required than of the wet one, the advantages attendant on its use render it, on the whole, a cheaper preparation. Some of its advantages are that it is prepared by the manufacturer, who can go to a better market for all the materials than the farmer, and, from conducting the operation on a large scale, can make it of better quality, both from the employment of suitable machinery, and from the skill acquired by the workmen ; and further, the expense of carriage and application to the land is not greater than that of an equal weight of unprepared bone-dust."

Except on land which contains a large proportion of organic matter, either the liquid or the dry preparation of bone-dust with sulphuric acid

ought to be applied for turnips, only in accompaniment with a moderate quantity of farm-yard manure. When the turnips are to be succeeded by winter wheat, indeed, the preparation of bone-dust and sulphuric acid may be administered alone, in order to force the turnips into rapid and vigorous growth, and to hurry them onward to speedy maturity ; but when the land is not to be cropped till spring, the accompaniment of some such slowly decomposing substance as farm-yard manure is in a greater or less degree indispensable, especially in a dry and hot season, for preventing an arrest upon the growth of the turnip bulbs before they arrive at their due size and weight. Five or six bushels of the dry preparation per acre, given in accompaniment with ten tons of farm-yard manure, have been found, from comparative trials on all kinds of turnip soils, to produce four or five tons more of turnip bulbs than can, in any equal circumstances, be obtained from 20 tons of farm-yard manure without bone-dust. "The dry preparation," says Mr. Shier, "has also been found a cheap and very efficient special manuring for grain-crops and grass. When used for grain crops, the best results have been got when it was applied to a grain crop immediately succeeding a green-crop grown after farm-yard manure alone ; and here too the same tendency to bring the plants early to maturity is manifested, the grain being ready for reaping fully a fortnight before portions of the same crop dressed with other manures ; the weight of the grain per bushel being increased, and the straw firm and healthy. Bone-dust, with sulphuric acid, has also been found to answer well for potatoes, especially when mixed with a little sulphate of magnesia."

Bone-manure is by no means equally suitable for all kinds of soils, but confers superlative advantage on one kind, medium advantage on another, and little or no advantage on another. An experimental trial, recorded by Mr. Sinclair, in a letter to the secretary of the Highland Society, states that it proved eminently fertilizing, not only for turnips but for the subsequent crops of a rotation, upon silicious soil, and that it produced scarcely any perceptible effect upon calcareous stony soil, while stable-yard manure upon the latter was eminently fertilizing. Four hundred parts of the silicious soil to which it proved most highly advantageous were ascertained by analysis to comprise 167 parts of fine silicious sand, 43 of calcareous sand, 99 of water of absorption, 24 of decomposing animal and vegetable matter, destructible by fire, 25 of impalpable carbonate of lime, 23 of silica, 9 of alumina, 3 of oxide of iron, 5 of soluble animal and vegetable matter, principally vegetable extract, with indications of muriate of soda, and 2 of moisture and loss ; and four hundred parts of the soil on which it did not appear to produce any benefit, comprised 217 parts of calcareous sand and gravel, nearly pure carbonate of lime, 17 of decomposing

animal and vegetable matters, destructible by fire, 39 of impalpable carbonate of lime, 85 of silica, 20 of alumina, 5 of oxide of iron, 4 of soluble matter, principally vegetable extract, with sulphate of lime, and 13 of moisture or loss. The two soils—whose most important chemical differences were the respective deficiency and excess of carbonate of lime, and the lesser or greater proportion of alumina—differed also in the important mechanical property of respective fineness and coarseness of their particles.—The report of the Doncaster Association on bone-manure corroborates, for the most part, the general principle of Mr. Sinclair, and, at the same time, exhibits it in more detailed application. "Upon very thin sandy land," says that report, "the value of bone-manure is not to be estimated; it is not only found to benefit the particular crop to which it is applied, but extends through the whole course of crops; and even in the succeeding courses, its effects are visible in the improved quality of the land, and the efficiency of a smaller quantity than would at first have insured a crop. Upon much of the high land about Babworth, which is a light sandy soil, the crops under ordinary farm management were comparatively unproductive; but since the introduction of bones, after having been dressed with several fallows with 60 or 70 bushels per acre, they have not only become productive, but so much improved in quality as to return an equal crop with a much lighter dressing of manure or bones throughout the next course." On the wolds of Yorkshire and Lincolnshire, "before bones were generally used with turnip seed, many thousand acres were annually sown for that crop without any manure whatever, from the impossibility of getting fold-manure for more than one-third or fourth of their fallows. The turnips upon such unmanured land were consequently very indifferent; and the benefit of sheep-feeding upon their tops—for of bottoms they seldom had any—was very trifling. Since the use of bones has, however, become general, the turnip crop has been in many instances tenfold, and in few less than four or fivefold its former bulk. All the succeeding crops of grain and seeds have been amazingly increased; and, upon the four or five shift system, there is no doubt the land will go on progressively improving, requiring a less quantity of bones annually, from its increased fertility and power." Upon even the calcareous soils of the Yorkshire wolds, land which formerly produced only from 8 to 10 tons of poor turnips per acre from farm-yard manure, now produces heavy crops of good turnips from 16 bushels per acre of bones. On well-drained and dry peat soils, a manuring with from 15 to 20 bushels per acre of bone-dust, applied in the drill method, has a far more powerfully fertilizing effect than any ordinary dressing of stable dung, or than even an application of pigeons' dung and lime. Gravelly soils of a light and dry character are

much benefited by bone-manure; but stiff clayey gravels, especially heavy water-logged yellow clays with admixtures of stones and grit, receive no benefit whatever from this manure, no matter in what manner it is applied. All clays and heavy loams, with such occasional exceptions as may be accounted for mainly on the influence of unusually dry seasons, are quite beyond the reach of any material fertilization from bones. Yet a farmer near Nantwich in Cheshire states, in the *New Farmer's Magazine*, "that he occupies a farm, the soil of which is a clay loam, scarcely 12 inches deep, the subsoil a grey sand mixed with coarse clay, which the farmers call rammel, on a bed of good clay marl; and that two years ago, he covered the field with bone-manure, previous to which the grass was so sour as not to be worth ten shillings per acre, but it is now full of most excellent herbage, consisting of white clover and trefoil;" and he adds, "that, in another of his fields with a clay soil, a small portion of it was manured 32 years ago, by a former tenant, with bones, and that, although it has been 20 years in tillage, yet that part still shows a superiority over the rest."

The aggregate opinions of farmers as to the length of time during which bone-manure operates on the soil may be gathered from the prevailing rates of allowance for it in the valuations of farms. In some places an allowance of six years is made for bone-manure on pasture, of four years on grass lands successively mown, and of four years on arable land; in other places, of ten years on pasture, six years on mown grass lands, and four or six years on arable lands; and in other places, a still larger allowance. When one white crop has been taken after the application of bone-manure, two-thirds of the prime cost and of the expenses are allowed; after two white crops are taken, one-third is allowed; and after three are taken, no allowance is made. But bone-dust is adjudged less durable than merely crushed bones, is valued at one tillage less than the latter, and usually ranks in valuation with farm-yard manure, or is regarded as coextensive with a four years' rotation. The actual power of bone-manure upon the soil, however, is in many instances of vastly longer duration than these rates of allowance would seem to indicate. One field, noticed in the Doncaster report, was manured in one part with bones and in another part with farm-yard dung; and the boned part was visibly superior to the other during the long period of 15 or 16 years. Another instance, noticed in that report, is precisely similar to the preceding, but exhibits visible improvement from the bones during even a much longer period. Another and still more remarkable instance, reported in the *Quarterly Journal of Agriculture* of March 1832, exhibited the reclamation of almost wasteland by means of bone-manure about 25 years before the close of last century, and the continuance of visible good effects from the bones down to the time at which the report

was written. Many other instances of enduring advantage might be given, and hundreds of instances of well-conducted and most interesting and successful experiments might be quoted; but, in the present advanced and universally diffused state of information respecting the practical worth of bone-manure, any further appeal to experience is altogether unnecessary.

The mode in which bone-manure acts upon the soil and upon plants is an important topic of inquiry; but cannot be understood without allusion to the chemical analysis of bones. A rough but common estimate of the constitution of the best kinds of bones employed in manure asserts them to consist of 40 per cent. of earthy and saline matter, 40 of cartilage and jelly, and 20 of fatty matter. But these proportions vary in different classes of animals, in individual animals at different ages, and in the same kind and age of bones in different states of preservation; and the specific nature and normal amount of the earthy matters in any one variety of bones employed for manure require to be minutely noted. The bones of not a few genera and orders of animals differ most widely from one another, in the proportions of the very elements, such as the carbonate of lime and the phosphate of lime, which have either the most peculiar or the most powerful manurial action. For example, the quantity of carbonate of lime which is combined in bones with every 100 parts of phosphate of lime, is 2.52 in fish, 2.63 in lions, 5.76 in frogs, 11.70 in fowls, 19.54 in man, and 24.12 in sheep. The bones of very young animals are soft, and principally consist of cartilage, in which the earthy matters are afterwards gradually deposited; and the bones of the same animals, when they attain maturity, possess a large proportion of both earthy and fatty matters, but vary according to food, health, and habits. Spongy bones or bones of loose texture have a comparatively large proportion of vessels and consequently of organic matter; and compact bones are comparatively abundant in earthy phosphates. According to the mean of four analyses of these two kinds of bones from the same animal, spongy bones contain 37.82 per cent. and compact bones 31.20 per cent. of organic matter, spongy bones contain 50.81 per cent. and compact bones 59.10 per cent. of earthy phosphates, and spongy bones contain 11.29 per cent. and compact bones 9.77 per cent. of carbonate of lime. Bones which have long been exposed to the air, whether on the open ground, or at such a small depth beneath the soil as to be accessible to atmospheric influence, are deprived of a large proportion of their original quantity of organic matter. Some bones of the bear which had been buried for an unknown length of time near the surface of the ground, yielded by analysis 4.20 per cent. of organic matter, 62.11 of phosphate of lime, 13.24 of carbonate of lime, 12.25 of sulphate of lime, 2.12 of fluoride of calcium, 0.50 of phosphate of magnesia, 2.12 of silicic acid, 2.12 of

oxides of iron and manganese, and 1.34 of soda; and some bones of the bear which had lain buried for an unknown length of time at a considerable depth in the ground, yielded 16.24 per cent. of organic matter, 56.01 of phosphate of lime, 13.12 of carbonate of lime, 7.14 of sulphate of lime, 1.96 of fluoride of calcium, 0.3 of phosphate of magnesia, 2.15 of silicic acid, 2.0 of oxides of iron and manganese, and 1.08 of soda. The analysis of human bones has been conducted far oftener and with greater care than that of any other kind of bones; and therefore deserves to be noted in connexion with our present subject. The thigh bone of an adult male, after being freed from periosteum and fat, and thoroughly dried, yielded 27.23 per cent. of cartilage insoluble in muriatic acid, 5.02 of cartilage soluble in muriatic acid, 1.01 of vessels, 52.26 of basic phosphate of lime, 1.0 of fluoride of calcium, 10.21 of carbonate of lime, 1.05 of phosphate of magnesia, 0.92 of soda, 0.25 of chloride of sodium, and 1.05 of oxides of iron and manganese, and loss. Most of the bones employed in manure are those of phytivorous animals, and in consequence contain considerable proportions of carbonate of lime.

The principal element in the manurial action of bones is the phosphate of lime. This salt is scarce in soils, sparingly dispersed, and speedily exhausted; and yet it is indispensable to the vigorous growth of nearly all cultivated plants, and forms the principal stimulant to the vitality and power of several. The phosphate of lime, Dr. Thomson asserts to be "a constant ingredient in plants;" and though it may be imperceptible in some, and but barely traceable in many, it constitutes a very conspicuous ingredient in the inorganic or ashy part of not a few of the most valuable. It is found in the pea-pod, in the marsh-bean, in the Scotch pine, in rice, in fuci, in the quinquina of St. Domingo, in the pollen of the date tree, and in the roots of the peony and the white water lily. "M. Raspael," we are told, "has detected it in the leaves of *Phytolacca decandra*, and in the bulbs of the orchis, ornithogalum, and narcissus, under the form of needle-shaped crystals attached to the exterior of the cells." According to analyses by Saussure, Vauquelin, and some other eminent chemists, 39.3 per cent. of it are contained in the ashes of the grain of oats, 44.5 in the ashes of the seeds of wheat, 46.5 in the ashes of bran, 32.5 in the ashes of the seeds of barley, 7.75 in the ashes of the chaff of barley, 6.2 in the ashes of the straw of wheat, 27.92 in the ashes of the seeds of vetches, 17.5 in the ashes of the seeds of pease, 22.5 in the ashes of the ripe plant of turnsole, 24.0 in the ashes of the leaves of oak, 4.5 in the ashes of the wood of oak, 4.5 in the ashes of the bark of oak, 13.0 in the ashes of the leaves of poplar, 16.75 in the ashes of the wood of poplar, 23.0 in the ashes of the leaves of hazel, 35.0 in the ashes of the wood of hazel, 5.5 in the ashes of the bark of hazel, 23.0 in the ashes of the wood

of hornbeam, and 4·5 in the ashes of the bark of hornbeam. These proportions forcibly show how indispensable the phosphate of lime is to the health and growth of the most useful plants of both the farm and the forest, and, in consequence, how mighty an influence is exerted upon them by bone-manure. Turnips, potatoes, and white clover, too, though not named in our list of special plants, are so powerfully affected by the presence of phosphate of lime in the soil as to be mainly dependent on it for their vigour and luxuriance. White clover, when well stimulated by bone-manure, grows with such energy as to take almost entire possession of the soil, or to dwarf and exterminate the coarse kinds of herbage; and, when first grown upon boned ground in England, was foolishly, though not very naturally, supposed by some farmers to derive its very seeds from the bone-manure, so that, as they imagined, it did not require to be sown. The seeds of this plant, not only contain a large proportion of phosphate of lime, but possess extraordinary longevity, and are most extensively though dormant diffused in almost all kinds of soils and situations in England; so that whenever they are brought within the reach of aeration, and subjected to the manurial action of phosphates, they germinate and grow with surprising vigour. White clover has sprung up after a conflagration in a large town, simply because the action of the heat occasioned aeration of the ground, and the incineration of the wood set free upon the soil a comparatively large proportion of phosphate of lime; and, for similar reasons, it has sprung up as if by magic, and flourished with almost supernatural luxuriance, in fields which have been suddenly phosphatized by the introduction of bone-manure. The highly fertilizing power of phosphate of lime, also, affords a main explanation of the fact that bones are beneficial nearly in the ratio of the porosity of the soil, and are almost totally useless in wet tenacious clays; for this salt, as it exists in bones, is always slow of liberation, and can in any case be set free only under the action of the air; and hence it is readily evolved in soils which possess a full and rapid aeration, and remains perfectly fixed and stubborn in soils which lock it up from atmospheric influence.

But another powerful method in which crushed bones exert a fertilizing power, consists in their extraordinary capacity for absorbing and retaining moisture. When any vigorous plant upon a boned field is pulled up, it will generally bring up small pieces of bones with its roots; and when it is minutely examined, it will be seen to have grasped the little pieces and pervaded their cavities with its radical fibres, while these cavities will be seen to be clammy or even copious with the liquid nourishment on which the spongioles were feeding. The very contact which the radical fibres of young turnips obtain with bone-manure, and which they cannot, in any of the

ordinary methods of application, obtain with farm-yard dung, has been assigned by some intelligent farmers as the sole reason of the paramount power of bones over the turnip crop.—“Contact with manure,” says a writer in the 41st number of the Quarterly Journal of Agriculture, “will cause turnip-seed to vegetate in a short time. Could the seed have been placed in contact with farm-yard manure as easily as with bone-dust, the latter would never have acquired the fame it has as a turnip manure. The firmness with which the roots of the turnip grasp the manure, shows the great capacity for manure which they possess in the early stage of their growth. It is this tenacity for manure of the root-fibres which raises so much of the bone-dust to the surface of the ground, by adhering to the roots of the ejected plants; for it is found, in singling the turnip crop it is liable to be brought up to the surface of the ground, by the root-fibres of the ejected plants; and whenever turnip-seed vegetates in contact with farm-yard manure, the same inconvenience results.” The plentiful supply of moisture for turnips which bone-manure attracts and maintains in open and comparatively arid soils, affords another though but secondary explanation of its specially beneficial action upon light and porous land; and the repulsive power which fatty matter exerts against moisture, fully explains the apparent superiority of boiled bones to unboiled ones in fertilizing effect upon the turnip crop.

Another source of the manurial power of bones, though applicable, not to the turnip crop, but to the succeeding crops of the rotation, is their gelatine and their fat. Both of these substances consist of elements which enter very largely into the organic substance of all plants; so that, throughout the whole process of their decomposition on the soil, they resolve themselves into direct and perfectly prepared food for the growing crops. The more the bones have been fermented, too, the more soluble is their gelatine, and the more prepared for assimilation is their fatty matter; and hence the high advantage of working unboiled bones into fermented composts, or mixing them with foreign substances fitted to promote their fermentation. Yet as the presence of oil and gelatine resists the attraction of moisture, retards the development of the manurial power upon turnips, and constitutes a kind of manurial agency similar to that of the most common fertilizers, and not at all of the specific and mighty nature of the phosphate of lime, a very serious question arises whether more profit might not accrue to the farm from extracting the oil and the gelatine from all unboiled bone-manure, and applying them to other uses. “By comparing all the facts,” says one writer, “we naturally come to the conclusion, that the most economical use of bones is to extract from them the oil and gelatine, which, if not of sufficient value for the manufacture of glue or of ammonia, may be

used as a supplementary food for pigs, in the form of a broth or pot liquor, which, mixed with meal, will greatly accelerate their growth or increase their fat." When rapid action upon turnips is desired, either this measure, or thorough previous fermentation, or digestion in sulphuric acid, ought to be adopted; and in every instance in which large quantities are in requisition, a calculation ought to be made as to which of the several methods of applying bone-manure will prove most economical for the general results of the rotation or of the farm.

A method of preparing bones by steam was recently published by Mr. James Blackhall of Edinburgh; and claims to be a much cheaper method than the crushing one, and more facile than that of solution in sulphuric acid, and at the same time equally efficient. It consists in exposing them for a certain length of time to the action of high-pressure steam; and it brings them into a state of such fine division, as may readily though mistakenly be supposed by a general observer equivalent to solution. Dr. Anderson, the chemist of the Highland and Agricultural Society of Scotland, found by analysis that a specimen prepared by Mr. Blackhall himself consisted of 12.66 per cent. of water, 27.37 of animal matter, and 59.97 of bone-earth, and that a specimen prepared according to Mr. Blackhall's method by another gentleman consisted of 13.86 per cent. of water, 19.90 of animal matter, and 66.24 of bone-earth; and in order to make a determination of their relative value, he at the same time analysed a specimen of ordinary one-inch drill bones, a specimen of ordinary fine-crushed bones, and a specimen of entire bones in the state in which they are sold to the bone crushers by the persons who collect them in Britain, and found the first to consist of 10 per cent. of water, 41.88 of animal matter, and 48.12 of bone-earth,—the second to consist of 10.39 per cent. of water, 42.6 of animal matter, and 47.01 of bone-earth,—and the third to consist of 14.89 per cent. of water, 37.02 of animal matter, and 48.17 of bone-earth. Steamed bones are thus one-half or less poorer in gelatinous or nitrogenous principles than crushed bones; and though a process might be adopted for recovering the lost gelatine, to be used either in stock-feeding or in compost-manure, yet the consequent cost and trouble would probably go far or even go all lengths or more to neutralize the alleged economy of the steaming method. "Mr. Blackhall's process," concludes Dr. Anderson, "may, notwithstanding prove valuable in remote districts, where small quantities of bones may be collected at such a distance from a bone-mill as to render it impossible to transport them to it. The superiority of steamed bones as a manure is a question which can be properly determined only by experiment in the field; and it is not impossible that good results may be obtained from them, though they can never form a substitute for bones dissolved by an acid."—*Reper-*

tory of Inventions.—*Report of the Doncaster Agricultural Association on Bone-Manure.*—*New Farmer's Magazine.*—Nos. 1, 6, 16, 18, 20, 24, 41, 47, 50, 57, and 59, of the *Quarterly Journal of Agriculture.*—Vols. 2, 4, and 5, of the *Journal of the Royal Agricultural Society.*—*Transactions of the Highland Society.*—*Catalogue of the Highland Society's Museum.*—*Bayldon on Rents and Tillages.*—*Mill's Husbandry.*—*Davy's Agricultural Chemistry by Shier.*—*Liebig's Chemistry of Agriculture.*—*Turner's Chemistry.*—*Thomson's Chemistry.*—*British Husbandry.*—*Rham's Dictionary of the Farm.*

BONE-MILL. See BONE-MANURE.

BONE-SPAVIN. A bony excrescence or hard swelling on the inside of the horse's hock. It assumes various aspects and possesses various virulence, from a slight and easily curable damage to an inveterate blemish or incurable disease. It is induced by kicks, bruises, leaping, overstraining, and rapid galloping, but especially by the overworking of a young horse before its limbs have become properly knit, and by the absurd though common practice of forming a horse's shoes with raised parts, on the outer heel. A spavined horse is usually quite able for slow work, and may not only take part in most of the draught-labour of a farm, but derive benefit from the laborious but steady exercise of his limbs. A farmer will generally procure such an animal at a comparatively low price, and may find him an excellent bargain. The slow, regular, and heavy action of the limbs in plough-draught, rouses the absorbent system to vigorous action, and incites it to withdraw a portion of the bony matter which forms the excrescence, yet without either renewing the local irritation or inflammation; and therefore achieves an important alleviation of the disorder. The proper medicinal application for any ordinary bone-spavin is a blister.

BONPLANDIA, CUSPARIA, or GALIPEA. A small genus of medicinal and ornamental, ever-green, dendritic, tropical plants, of the rue or diosma tribe. The best known species was originally designated by Humboldt *Casparia febrifuga*, and retains that name in the London Pharmacopœia; it was afterwards called by M. Saint Hilaire *Galipea febrifuga*; it was next called by Aublet *Galipea trifoliata*, and entered under that name in Loudon's *Hortus Britannicus*; but it was designated by Willdenow *Bonplandia trifoliata*, and this last name was adopted by Humboldt, and is received in the Pharmacopœias of Edinburgh and Dublin. Yet its bark, which is the part used in medicine, is called sometimes cusparia bark, sometimes bonplandia bark, and most frequently angustura bark.

This plant grows abundantly in the woods on the coast of the gulf of Santa Fé, and in the adjoining districts of South America. Its trunk is cylindrical, has a greyish bark, rises to the height of from 20 to 80 feet, and ramifies towards the

summit; its branches are alternate,—the upper ones nearly horizontal; its leaves are alternate, have a length of about two feet, stand upon leaf-stalks of from 10 to 12 inches in length, and consist each of three oblong ovate leaflets, with pointed extremities, glandular, and agreeably aromatic; its flowers are funnel-shaped and five-petalled, and form terminal racemes of from three to six; and its fruit consists of five oval bivalve capsules, each containing a single seed. The plant was introduced to Britain about forty years ago, as an ornament of our bark stoves; but it attains with us a very paltry height. Its bark was first introduced from Dominica in 1778, and continues to be imported in casks. Its odour is peculiar, but not strong; its taste is bitter, slightly aromatic, and enduringly hot and pungent in the throat; its chief chemical principles are resin, carbonate of ammonia, volatile oil, igasauric acid, a peculiar kind of extractive, and probably some cinchonina; and its medicinal virtues are well established in cases of intermittent fever, dysentery, bilious diarrhoea, hysteria, leucorrhoea, dyspepsia, and general debility of the stomach. It is administered, in small doses, in a state of powder, of tincture, of watery extract, and of watery infusion. But a most deleterious substitute for it, containing the narcotic principle brucia, is frequently met with in the market, and has been designated *Angustura ferruginea*, and may readily be distinguished by its greater weight and thickness, and by its warty and brownish-olive epidermis.—A dwarfish and very fragrant species of Bonplandia, called *Galipea odoratissima*, was recently introduced to our hothouses from Rio Janeiro.—The name *Bonplandia gemmiflora* is given by the Spanish botanist Cavanilles to a tender ornamental annual of the polemonium tribe, known to other botanists as *Caldasia heterophylla*.

BONUS HENRICUS. See GOOSEFOOT.

BOOK-KEEPING, See FARM-ACCOUNTS.

BOOSE, or Boosing. A stall for cattle. A boose-stake or a boosing-stake is the post at the head of a stall, to which an ox or a cow is fastened.

BORACIC ACID. See BORATES.

BORAGE,—botanically *Borago*. A genus of herbaceous plants, forming the type of the natural order *Boraginæ*. This order comprises twenty-six genera, and has growing in Britain about 280 species, two of which are hardy ligneous, and about 194 hardy herbaceous. Most of the species have alternate exstipulate leaves, covered over with minute asperities; and all have their flowers arranged in a gyrate manner previous to expanding,—each flower followed by four distinct little nuts or seeds. The type of the order, found in the common borage, is one of the truest types in Jussieuan botany, and represents both the peculiar structure and the sensible properties of all the genera, and even of all the species; so that its insipid juice, and its covering of stiff white hairs, are common to the whole order; and the latter property formerly occasioned all the spe-

cies to be designated asperifolium or rough-leaved. Some are mere weeds; others, and these not a few, are eminently beautiful; most are mucilaginous and emollient; several contain nitre; and a considerable number are employed, in various countries of the world as well as in our own, for imparting a red colour by dyeing.

The borage genus comprises seven species, six of which are cultivated in Great Britain. The common borage, *Borago officinalis*, grows wild among rubbish in England, and is a well known annual plant in many, perhaps most, of our gardens. Its tops and its young leaves are used as a salad, or boiled as a pot herb, or put into negus or cold tankards. The English peasantry regard the leaves and flowers, when warmed up in beer, as a cooling cordial and opening medicine; and they also employ them in some places as an ingredient in brewing. Its stems are round, juicy, thick, between two and three feet high, and so beset with small stiff hairs as to be almost prickly to the touch; its leaves are large, broad, rough, wrinkled, and hairy; its flowers are five-petalled, have a bright blue colour, and bloom from May till September; and its seeds are small, oval, and black, with generally a speck of white at their lower end. If permitted to sow itself, it will come up in plenty, and grow with vigour, in the manner of a weed or wild plant. But it may be artificially sown, either in spring or in autumn, on any spot of open ground where it is wished to grow to maturity; and when the plants have attained a little strength, they may be cleared of all weeds, and thinned out to distances of six or eight inches. Plants raised in autumn flower in May; plants raised in early spring flower in June; and when the longest possible succession of fresh plants is desired, a second sowing or even a third may be made in spring. But late spring-sowings must be made on a shady border; and, if the season should prove dry, they must be followed by frequent waterings. Three varieties of the common borage are pretty constant from seed, one with white, another with red, and a third with variegated flowers; but only the first of these, *Borago officinalis albiflora*, can be considered permanent. A writer in a Bavarian Weekly Journal, recommends that common borage should be artificially sown in fields, and, when full-grown, ploughed into the ground as manure; he says that he has, by long experience, proved the excellence of its manurial character; he ascribes this excellence principally to its containing so large a proportion of soda and other salts; and he remarks that it may be sown in April, and ploughed down in August in time to be followed by wheat. But in so completely inland a country as Bavaria, where saline vapours must be few and attenuated, we cannot understand how borage should return to the soil much more saline matter than it extracts from it; and even in seaboard districts, where saline vapours are abundant, we should be

a little puzzled to know how the occupancy of a field with borage throughout a season, or even in lieu of summer fallow, could comport with either good husbandry or true economy.

The long-leaved borage, *B. longifolia*, is a recently introduced hardy ornamental annual, of a foot in height, from the south of Europe.—The loose-flowered borage, *B. laxiflora*, is a hardy, trailing, ornamental biennial, of a foot in height, from Corsica.—The oriental borage, *B. orientalis*, is a beautiful hardy herbaceous perennial from Turkey, two feet in height, and producing handsome blue flowers from March till May.—The Cretan and the thick-leaved species are also perennials; and the latter was introduced a few years ago from Persia, grows to the height of two feet, and produces pink flowers in June and July.—*Miller, Marce, Mill, Loudon, Smith, Johnson.*

BORASSUS. A beautiful and most valuable oriental tree of the palm tribe. It is called by the Hindoos *Tala*; by the Portuguese, *Palmeira brava*; and by the English *Palmyra tree*. Only one species, designated the fan-leaved, *Borassus flabelliformis*, is known with certainty to botanists; but several varieties, and possibly several species, have been described under this name. It abounds in most parts of both insular and continental India, and possesses very high economical value wherever it grows; yet it appears to be circumscribed by capricious limits, and is scarcely or not at all to be found in some places where it might be supposed to be both abundant and luxuriant. Its stem has a height of from 20 to 40 feet, and is perceptibly thicker at the base than at the summit; its leaves are fan-shaped, each about four feet long, situated on a spiry leaf-stalk of about the same length, and divided into 70 or 80 ragged rays; and its fruit is somewhat triangular, is as large as a child's head, has a thick, fibrous, brownish, and somewhat succulent rind, and contains three seeds, each about the size of a goose-egg.

"This magnificent palm," says Sir William Jones, "is justly considered the king of its order, which the Hindus call *Trina druma*, or grass-trees. Van Rhee de mentions the bluish, gelatinous, pellucid substance of the young seeds, which in the hot season is cooling and rather agreeable to the taste; but the liquor extracted from the tree is the most seducing and pernicious of intoxicating juices. When just drawn, it is as pleasant as Pouhon water fresh from the spring, and almost equal to the best mild champagne. From this liquor, according to Rhee de, sugar is extracted; and it would be happy for these provinces, if it were always applied to so innocent a purpose." Yet in spite of this wicked abuse of its sap, the borassus is as important to the inhabitants of some tropical districts as the cocoa-nut tree is to those of others. For example, forests of the borassus and very few trees of *Cocos nucifera* occur in the north of Ceylon, while

forests of *Cocos nucifera* and very few trees of the borassus occur in the south of that island; and the northern Cingalese depend, for a considerable portion of their food and of the articles which they export, upon the borassus, while the southern Cingalese depend, for just the same things, upon the cocoa-nut tree.

The toddy or intoxicating juice of the borassus, when temperately used, is said to be cooling and aperient, and is frequently prescribed in cases where a gentle stimulant is required. When the fruit is half grown, it contains a fresh-tasted gelatinous pulp, which is cooling and rather agreeable, and is called Noonghoo by the Tamuls; but when the fruit ripens, the pulp changes into a hard, bluish, albuminous substance which is insipid and inedible. The young plants, when but a few inches high, are used as pot vegetables by both the Hindoos and the Cingalese; in some districts, they are dried, and pounded into a sort of meal; and in most, they are boiled, and eaten with a little of the kernel of the cocoa-nut. The leaves of the full-grown trees are used by the Hindoos for house-thatch, fans, baskets, hats, mats, umbrellas, buckets, temporary huts, and a substitute for writing-paper; and when employed for the last of these purposes, they are written upon with an instrument of steel. The outer wood is brown, very hard, capable of longitudinal division, and susceptible of a fine polish; and it is frequently employed for making bows. The wood of a particular variety, usually procured in other parts of India from Jaffnapatam, is hard, close-grained, and dark-coloured, and is considered a valuable timber for house-building and other purposes. All the sugar used by the Cingalese is made from *Borassus flabelliformis*, *Cocos nucifera*, and *Caryota urens*. The borassus was first introduced to the palm-houses of Great Britain in 1771.—*Materia Medica of Hindostan.—Extracts in Gardener's Magazine.—Sir W. Jones' Plants of India.—Loudon's Hortus Britannicus.*

BORATES. Chemical combinations of boracic acid and alkaline bases. The chief of these for all economical purposes, and also for all chemical associations with boron, is the baborate of soda, popularly called borax. Boracic acid may be prepared from borax; and boron is usually obtained from boracic acid.

Boron, so far as chemistry has yet been able to determine, is a simple or elementary body. It is dark, olive-coloured, tasteless, odourless, insoluble in water, ether, alcohol, or oils, about twice the weight of water, and capable of bearing an intense heat in a close vessel without undergoing fusion; and it is separated from the oxygen of boracic acid, and obtained in a separate state, by driving the oxygen into combination with potassium by means of heat.

Boracic acid is the only known compound of boron and oxygen; it exists naturally in the hot springs of Lipari, Volterra, and Sasso; it is a constituent of boracite, datolite, and some other

minerals; it was formerly called sedative salt of borax, and Homberg's sedative salt; it was at one time used as a medicine, and is still occasionally employed in chemical investigations; and it is obtained in a separate state, either from the hot springs of Italy by evaporation, or from borax by driving the soda of that salt into chemical combination with sulphuric acid. It commonly retains some water of crystallization, or is what chemists call a hydrate; and when freed from this water by gradual application of intense heat in a platinum crucible, it becomes vitrified, or is a hard, colourless, transparent glass, but with such affinity for water that, if allowed to remain in contact with the air, it imbibes moisture, and becomes opaque. In any condition, even in chemical combination with alkaline bases, as in the case of borax, it is exceedingly fusible, and has long been known in the useful arts as a valuable flux.

Impure borax, in a natural condition, and under the popular name of *tincal*, exists in inexhaustible or constantly renewing quantities round the edges and in the shallows of a lake, twenty miles in circumference, in Thibet. The pure borax of commerce was formerly obtained by purification from the *tincal*; but is now manufactured by saturating with carbonate of soda the boracic acid which is procured from the hot springs of Italy. It usually forms into irregular crystals, somewhat resembling hexangular prisms with superimposed triangular pyramids; and it has a white colour, no smell, and a cool, alkaline, styptic taste. It possesses refrigerent and detergent properties as a medicine; yet it is not administered internally, but is used principally as a wash or a cleaning powder, in cases of excessive saturation or of aphthous affections of the mouth. Nurses have a careless and censurable fondness for sprinkling small portions of the powder of it in the mouths of infants; most farriers approve of a solution of either this salt or alum being used as a wash for the inflamed mouths of young horses during the process of dentition; and some pharmacutists think that the medicinal use of borax might, with eminent advantage, be adopted for some internal purposes, and very greatly extended in external applications.

BORAX. See **BORATES**.

BORBONIA. An interesting genus of Cape-of-Good-Hope, evergreen, ornamental shrubs. They belong to the furze or broom subdivision of the butterfly portion of the pea tribe. Nine species have been introduced to Great Britain, and three other species, once ranked as borbonias, but now assigned to other genera, have also been introduced. Eight of the nine produce yellow flowers,—chiefly in July and August,—and vary in usual height from three to six feet; and the other species, the heath-leaved, grows to the height of about two feet, and produces pink flowers in January and February. Five of the species were introduced in the course of last century.

BORDER. The part of a pasture field situated along the hedge; the end part of a ploughed field, on which the teams turn; the belts of a fruit garden appropriated to the cultivation of the choicer fruits; and the bands, scrolls, figures, or plots of a flower garden, appropriated to the cultivation of all such hardy flowering plants as are not tall or shrubby. But the word, in the last of these senses, though the most general in use, has almost ceased to have any literal or proper meaning. In the old geometric style of gardening, borders were either straight, circular, or otherwise regular, though turned into knots, scrolls, voluces, and other compartments, and were capable of classification into four kinds. The most common kind were continuous belts around parterres, wrought with a gentle rising along the middle, and planted with herbaceous flowering plants and low flowering shrubs. Another kind were cut into even compartments, at convenient distances, by small passages, and raised and planted like the preceding. The third kind were made flat, occupied athwart or along the middle with grass, edged with two smooth and sanded paths, and garnished either with flowering shrubs, or with vases and flower-pots placed regularly along the middle of the grass. The fourth kind were made quite plain, and only sanded as in the parterres of an orangery, and occupied with regularly arranged cases, with sometimes a yew tree between every two cases. In large parterres, the borders were usually discontinued at the ends next the house, in order that the interior swells and embroidery might not be concealed by the shrubs and flowering plants. "But," to adopt the words of Miller, "since the modern taste of gardening has been introduced into England, all the French taste of parterres, scroll borders, and fretwork in box has been justly banished our gardens: therefore I have only mentioned them here, to expose the taste of those architect-gardeners who have no idea of the noble simplicity of an open lawn of grass, properly bounded by plantations; but, instead of this, divide that part of the garden near the house into various forms of borders edged with box, and sand or gravel walks leading about them; by which the ground is cut into many angles, scrolls, &c.; which is very hurtful to the eye of a judicious person." See the article **GARDENING**.

BORD-LANDS. Lands which, under the feudal system, proprietors retained in their own possession for the supply of their board or table.

BORD-SERVICE. The tenure of bord-lands, which, under the feudal system, obliged tenants to find provisions for their superior's table. Some traces of this degrading tenure still exist; but the tenants affected by it pay only a small rent in lieu of the provisions.

BORECOLE, — botanically *Brassica oleracea acephala*. A variety of open cabbage, with tall stems, and large, open, curly-leaved head, serving for winter greens, and its side sprouts for spring

use. The thoroughly established subvarieties of it are Scotch kale, green kale, Siberian kale, or Sabellian borecole, *Brassica oleracea acephala sabellica*; the cavalier cabbage or branchy borecole, *B. o. a. ramosa*; the cow cabbage or tree borecole, *B. o. a. arborea*; German greens or curly borecole, *B. o. a. crispa*; the hundred-headed cabbage or common borecole, *B. o. a. vulgaris*; the oak-leaved borecole, *B. o. a. quercifolia*; the Chou-Palmier or palm-leaved borecole, *B. o. a. palmifolia*; and the Chou-de-Beauvais or ribbed borecole, *B. o. a. costata*. Some writers include also Brussels sprouts,—though this subvariety really belongs to the variety *B. o. bullata*, or classes with savoy cabbage; some appear likewise to include subvarieties of a ribbed kind, belonging to the variety *B. o. costata*; and some treat two or three of the subvarieties which we have named, as well as one or two others, under designations which modern systematic botany does not recognise,—such as spreading-leaved, upright-leaved, Anjou kale, Chou-de-Milan, purple borecole, variegated borecole, ragged jack, Egyptian or Rabi kale, Jerusalem kale, and Russian, Prussian, Buda, or Manchester kale. But by far the best-known, most extensively diffused, most tender, and most useful variety is the Scotch kale; and this has many shades and gradations of at once size, colour, curliness, shape, and character, and usually sports itself into several playful though perfectly evanescent subvarieties from any one sowing; and yet, amid all its sportiveness, it generally retains sufficient individuality to be easily distinguishable from all other subvarieties. Cobbet and some other men of Cobbet's stamp have been pleased, in their supercilious caprice, to denounce it as an abomination; yet almost all Scottish cottiers and farmers, and not a few of the inhabitants of Scottish towns, regard it as one of the most valuable productions of the kitchen-garden, and would sadly deplore the want of it in winter and early spring. So inveterately, however, do they close their ears to all other designations of it than kale, green kale, and Scotch kale, that some of their educated, professional men, who have for a score of years superintended its cultivation in their own gardens, are as profoundly ignorant of *Brassica acephala*, or of borecole, or even of Siberian kale, as of the topography of Saturn's moons.

The garden cultivation of the common kinds of borecole is the same as the garden cultivation of the cabbage. The best soil is fresh, deeply-loosened, tolerably strong loam; but any description of kitchen-garden soil will suit. The ground ought to be deeply dug, thoroughly pulverized, and richly manured. As the borecole comes into prime condition, immediately after the commencement of keen frost, or just when most other kitchen vegetables become unfit for use, and as it continues to be highly available up to the period of the spring shooting of its flower-stems, a succession of crops, in adaptation

to its biennial habit, may be kept in progress throughout the year, sowings being made in late spring or early summer for autumn transplanting, and sowings being made in autumn for spring transplanting. Seedlings from a sowing at the close of March are fit for pricking out at the end of April, for final transplanting at the end of May, and for full use in the latter part of autumn; seedlings from sowings in May are fit for final planting in July and August; and seedlings from sowings in August are in fine condition for final planting in March or the beginning of April. When both pricking out and transplanting are practised, the former should be done when the leaves of the seedlings are about two inches in breadth, and the latter about four or five weeks after the pricking out. Seedlings when pricked out should be set six inches asunder from one another, and kept in a moist condition till well established in the ground; and young plants, when finally planted, whether from a seed-bed or a nursery-bed, ought to be set in rows 30 inches asunder in spring and summer plantings, and 24 inches asunder in autumn plantings; if rain be not frequent or copious enough to keep them moist, they should be often watered till they become fully established in the soil; and, at more than one period of their advancing growth, they ought to be well earthed up to prevent them from being uprooted or overthrown. When seed is desired, the strongest plants, with well-marked characteristics of each subvariety, ought to be selected, and either allowed to stand where they grow, or removed during open weather between the end of October and the end of February, into rows three feet apart, in very deeply dug soil. But if they stand where they grow, they will require to be supported; and if removed, they ought, in transplanting, to be buried down to their heads. Propagation of any of the subvarieties may be effected, in dry weather, by slips from the stems; but this method is very little practised in Britain.

BORER. See **AUGER** and **ARTESIAN WELLS**.

BORING. Piercing the upper strata of a field with an auger, either to ascertain the nature of the subsoil, to examine the mineralogical character of the strata, to discover and tap springs which injure the immediate subsoil or the neighbouring ground, or to obtain a supply of good spring water in circumstances in which superficial springs or productive shallow wells do not exist. See the articles **AUGER**, **DRAINING**, and **ARTESIAN WELLS**.

Boring is also a piercing or perforating operation upon such trees as the birch and the American maple, to obtain as large a supply as possible of their sap in the season of their bleeding. Either a horizontal or a slanting hole is bored, with a wimble, to the depth of one inch or two inches into the wood; and through this a copious discharge of sap is obtained. A tree, though subjected to this operation for many successive

years, so as to have its trunk pierced with a number of holes, does not suffer material injury, but continues to be healthy and robust. Each hole, too, provided it be not unnecessarily large, gradually fills up, by the formation and projection of new alburnum and liber round the edges and sides of the orifice, until it becomes completely closed.

Boring was likewise an operation in former times, though a very absurd, useless, and barbarous one, for the cure of wrenching in the shoulders of horses. The operation was performed as follows. "They cut a hole in the skin, in the middle of the shoulder, and, with the shank of a tobacco pipe, blow it as a butcher does a shoulder of veal; then they run a cold flat iron, like a horseman's sword-blade, eight or ten inches up between the shoulder-blade and the ribs, which they call boring; after that, they burn him round the shoulder with a hot iron."

BORKHAUSIA. A genus of hardy herbaceous plants, of the succory division of the composite tribe. Twenty-one species have been introduced to Great Britain,—two from the north of Africa, one from North America, and the rest from the south of Europe; and two of the twenty-one are perennials, four are biennials, and the rest are annuals. One of the most interesting—though even this figures only as a second-rate ornamental plant—is the alpine species, *Borkhausia alpina*, formerly *Crepis alpina*, a hardy annual from the Italian alps. Its stems are strong, upright, about 18 inches high, and ramified into three or four erect branches; its radical leaves are numerous, oblong, pointed, five inches long, nearly two inches broad at the base, and growing near the root; its stem-leaves are sessile, hairy, rough, and of the same shape as the radical leaves; and its flowers have a pale yellowish white colour, are produced at the top of the stems, and usually appear in July. This plant matures its seeds in autumn, and, if not destroyed, will abundantly sow and propagate itself.

BORON. See BORATES.

BOSCAGE, or BOSQUET. A small wood, a mimic grove, or an umbrageous section of a large garden. The word is the diminutive of the Italian name for a grove or wood; and was technically applied, in the early part of last century, to a shrubby or dendritic compartment of a large garden, fancifully arranged in its trees or shrubs, and enclosed with an evergreen hedge.

BOSEA. An ornamental, evergreen, half-tender shrub, of the goosefoot tribe. Only one species, called *Yervamora*, and popularly golden-rod tree, is known in Great Britain; and this was introduced from the Canary Islands early in last century, and has since been found wild in some of the islands of North America. Its stem is strong, woody, about two feet in girth and eight feet in height; its branches come out irregularly, and make considerable shoots in summer; and its outline is handsome and imposing; yet its char-

acter, as an ornamental shrub, is greatly impaired by the necessity of housing or otherwise strongly protecting it in winter, and by the excessive difficulty, if not impossibility, of bringing it to flower.

BOSS. A slender triangular or conical cage in the centre of a rick or stack, to insure a circulation of air, and prevent heating and fermentation. A pole is adjusted to the centre of the rick-stand; three or more straight sticks are fixed slantingly against the pole, so as to form an open triangle or cone, with the base upon the rick-stand; and railings are nailed transversely upon the sticks, or a strong straw rope is fastened round them, to prevent the sheaves from falling in. The summit of the boss does not reach the top of the rick; but when the builder arrives at the summit, he attaches to it a sack filled with straw, and, having built round part or most of it, pulls it up from time to time till he completes the rick; and thus a free ventilation from base to top of the rick is secured. The boss is a Scottish invention, and is eminently useful in the ricking of beans and of the cereal crops in an unsettled and critical harvest. See the articles BEANS, STACK, and HARVEST.

BOSTRICHIDÆ, or XYLOPHAGI. A group of coleopterous insects, nearly allied to the weevils, and nearly as noted for their ravages in the forest as the latter are for their devastations on the farm. They are strongly characterized, by an exclusively lignivorous habit; and are popularly designated by names, such as wood-beetles, wood-eaters, and timber-borers, which show that this habit has long been observed and is generally known. Their head—at least in some of the most conspicuous species—is slightly elongated; their antennæ have a clavated extremity; their body is narrow and lengthened; and their tarsi are four-jointed; and thus they possess a considerable similarity of conformation to the weevil group. Though small in size, and individually feeble in effort and microscopic in achievement, they congregate in such myriads, and operate with such steadiness, and exert such power of combination, as to be the most formidable assailants of the strength and even life of our sturdiest and most stalwart forest-trees. Some feed within the wood, and others merely beneath the bark; and the latter are probably the most formidable. "Their general plan of proceeding, is to scoop out cylindrical galleries in the soft inner bark, which, as well as the woody substance of the tree, constitutes their food. These bores ramify in all directions, without however intersecting each other, or anastomosing, except in rare instances; and the death of the tree is occasioned by being barked, a complete separation being made between the wood and the superficial circulating system by which its growth is maintained. The bores or tubular paths sometimes form irregular figures, not unlike some kinds of written characters, or the rivers as delineated on

a map; hence such names as polygraphus, micrographus, and typographus have been fancifully conferred on certain of the species." Brief notices of the more remarkable or mischievous kinds will be found under the heads *Tomicus*, *Scolytus*, *Hylurgus*, and *Hylesinus*.

BOTANICAL GARDENS. Establishments in which plants from all climates, and all parts of the world, are cultivated in the open air, in green-houses and hothouses. The object of such an establishment is partly information and the improvement of science, partly pleasure and luxury. Theophrastus seems to have instituted the first botanical garden. He bequeathed it to his scholars. Attalus Philometor, king of Pergamus, and Mithridates Eupator of Pontus, vied with each other in the establishment of gardens, where they cultivated poisons and antidotes. Pliny mentions a botanical garden which was laid out in Italy by Antonius Castor, son-in-law of king Dejotarus. In the middle ages, Charlemagne exerted a favourable influence, by establishing gardens near the imperial palaces and castles, specifying even the single shrubs which were to be planted. In the beginning of the 14th century, Matthæus Sylvaticus, at Salerno, founded the first botanical garden, properly so called. The republic of Venice, soon afterwards, in 1333, instituted a public medical garden, and had the plants painted by Amadei. The paintings are still preserved. After the time of the revival of learning, the first botanical gardens, which contained, however, for the greater part, merely medicinal plants, were laid out in Italy. Duke Alfonso of Este was the founder of an excellent institution of this kind in Ferrara; then followed the gardens in Padua, Pisa, and Pavia. Montpellier, in France, first imitated his example. The academical garden in Leyden was instituted in 1577; that of Paris, in 1633; and about the same time the first botanical gardens in Germany and England were founded. At present, the largest and most renowned in Germany are the imperial Austrian, at Schonbrunn, under the inspection of Jacquin; the royal Prussian, near Berlin, under Link and Otto; that of Weimar, in Belvidere; that of the grand duke of Baden, at Schwetzingen; and the royal Hanoverian, in Herrnhäusen. In Great Britain, the royal garden at Kew, and the Chelsea garden, founded for the London apothecaries, are the most celebrated scientific institutions, to say nothing of the extensive gardens where plants are raised for sale. In France, the royal garden in Paris is the principal. Formerly, that of Malmaison, founded by the empress Josephine, was the most famous. In Italy, the garden of the university at Turin, is, perhaps, the best; in Spain, the royal garden at Madrid; in Denmark, the garden of the university at Copenhagen. In Russia, the excellent institution of the count Alexis Rasumowsky, at Corinka, near Moscow, deserves to be placed by the side of the most celebrated establishments.

The principal botanical gardens in the United States are in New York and Philadelphia. In Asia, the garden of the East India Company at Calcutta is the most important.—At present, almost all universities and learned academies, as well as many rich private proprietors, have botanical gardens.

BOTANY. The science of plants may be divided into two parts, one of which describes their external appearance, and is sometimes called *Phytography*; the other treats of their internal structure and organic action, and may be termed *Philosophical botany* or *Phytonomy*. The former requires a perfect knowledge of terminology,—the latter a thorough knowledge of the plants themselves,—with a view to a systematic classification of them according to fixed principles. The necessity of such a classification must have been felt as soon as the number of known plants became great, and their relations and analogies obvious. At the time of the revival of letters, hardly 1,500 plants were known from the descriptions of the ancients: at present, at a moderate estimation, more than 70,000 have been described. It is obviously impossible to introduce order into this infinite chaos, or to acquire any distinct knowledge, without the aid of general principles. Even in the 16th and 17th centuries, the founders of botanical science perceived that in plants, as well as in all other natural bodies, the essential and necessary parts must be distinguished from the accidental, and that a scientific classification must be founded on the former alone. Now it was obvious that the production of fruit and seed is the ultimate object of vegetation; and, accordingly, in the first attempts at classification, the relations and component parts of the seed and of the fruit were made the foundation of the arrangement. This arrangement was confirmed by an observation of the uniformity of nature in the formation of those parts in plants of similar kinds. But it was found, also, that uniformity in these formations prevailed in too great a number of plants to allow them alone to be made the distinguishing characteristics. It became, therefore, necessary to have recourse to other parts. The flower was first chosen, as it presents a great variety of forms, and at the same time a uniformity of structure. But the limits to this uniformity, and the absence of flowers in innumerable plants, with the consideration that they are not essential, suggested to the immortal founder of modern scientific botany the idea that the sexual parts are most intimately related to the growth of the fruit, and that they are, therefore, of the greatest importance, and furnish better grounds of classification than the flower. A general principle was thus established, fertile in consequences, excellently adapted to facilitate the diffusion and extend the sphere of the science. The Linnæan system was founded exclusively on the relations of the sexual parts. Linnæus divided all known plants into two general divi-

sions, one of which has visible sexual parts (*phanerogamous*), while in the other they are invisible or wanting (*cryptogamous*). The first division comprehends the 23 first classes of his system, which are distinguished according to the situation of the sexual parts in the same or in separate flowers, their number, their length, &c. If any system has introduced order in the midst of variety, and shed light on the immense diversities of nature, it is that of Linnæus. Hence, even those who have departed from it in their writings have considered it necessary for elementary instruction. Many objections, however, are brought against it. It has been made a question whether it is fitted for the investigation and classification of unknown plants. It is said that the sexual parts may be very different in similar plants; that he never will have a complete idea of nature who proceeds only on one principle. It has, therefore, been thought necessary to find a more natural arrangement. In order to follow nature, we must look at every part; at the internal structure, as well as the external relations, analogies, and differences. This can be done only by a profound and toilsome investigation, of which the mere follower of a system has hardly a notion. Seed is considered as the ultimate object of vegetation. Its parts, their formation, situation, and other relations, must be critically examined. The most perfect natural system, in modern times, is that of Jussieu, particularly as enlarged by Decandolle.

The second general division of this science begins with the investigation of the internal structure, or the anatomy of plants. This study has been recently cultivated, by the Germans, to an extent which, forty years ago, could hardly have been conceived. It is closely connected with the first division, if the plants are studied in their natural order. Without good microscopes, and the aid of the best works in this branch, a distinct knowledge of the structure of plants cannot easily be obtained. Chemical botany must be connected with the anatomy of plants. Their constituent parts, their various changes, and the different combinations of their liquid and solid parts, are to be examined. From those we ascend to the laws of vegetable life, which are, in general, the same as those of animal life. Animal physiology must, therefore, be intimately united with the physiology of plants. Connected with the latter are two branches of knowledge, which the botanist cannot well dispense with, since they offer the most important conclusions on the economy of nature, on the history of the earth, and on the application of science to the arts. These are, first, the science of the deformities and diseases of plants, which can be made certain only by correct physiological views, and which is of great value in gardening, agriculture, and the cultivation of woods; and, second, a knowledge of the mode in which plants have been spread over the earth. If we study the forms of

vegetation which have come to us from distant ages, in the floetz formations, this observation affords the most interesting discoveries in relation to the history of our earth. If we trace the laws by which vegetation seems to have been distributed, we extend our knowledge of the general action of nature, and arrive at conclusions which may be of great practical utility. The work of Sprengel on the structure and nature of plants, is, perhaps, the most complete. Separate parts of the anatomy of plants have been treated of by Link, Treviranus, Moldenhawer, Keith, Ellis, and Mirbel; vegetable chemistry by Senebier, Saussure, Schrader, Liebig, Boussingault, and others.

SYSTEMATIC BOTANY.—Systematic botany has been defined to be "the science of arranging plants in such a manner, that their names may be ascertained, their affinities determined, their true place in a natural system fixed, their sensible properties judged of, and their whole history elucidated with certainty and accuracy." To facilitate the arrangement of plants according to their relationship, they are distributed into groups of higher or lower rank, the more general ones comprising the subordinate; species being brought together into genera or kinds, genera arranged under tribes or orders, and these under classes or more comprehensive divisions.

A *species*, or particular sort, embraces all the individuals which, slightly differing perhaps in size, colour, or similar unimportant respects, yet resemble each other more closely than they do any other plants, so that they may be deemed, or proved to be the produce of a common parent: and the seeds which they bear will yield similar individuals. Two seeds, however, taken from the same pod, will in many cases produce flowers of a different colour, or with different markings; or will give rise, if grown in different situations, the one to a nearly smooth, the other to a hairy plant; the one to undivided, the other to lobed or cleft leaves, and to numberless similar diversities. These minor differences, not incompatible with a common origin, but in fact tending to revert (at least in a natural state) to the type of the species, constitute *varieties*.

A *genus* is an assemblage of nearly related species, agreeing with one another in general structure and appearance more closely than they accord with any different species. Thus, the sweet-brier, the dog-rose, French rose, cinnamon rose, and others, constitute the universally-recognised genus *Rosa*; the various species of raspberry and blackberry compose the genus *Rubus*; the apple, pear, &c., the genus called by botanists *Pyrus*: so the different oaks, willows, poplars, birches, &c., form as many separate genera. When two or more species of a genus resemble each other in particular points more nearly than they do the other species, intermediate sections are often recognised; which, when well marked by characters of considerable importance, receive the title of *subgenera*.

Orders, or families, are groups of nearly allied genera; just as genera are of related species. Thus, the rose, the raspberry and blackberry, with the strawberry, the apple, the thorn, the plum and cherry, &c., all agreeing in their general plan of structure, are brought together into one order or family, and termed *Rosaceæ*; that is, *Rosaceous*, or *Rose-like plants*. But the plum and cherry are evidently more nearly akin than the cherry and apple, &c.; and so the raspberry, blackberry, and strawberry on one hand, and the apple and thorn on the other, exhibit a closer relationship than that which connects them all in one common group. Hence they are respectively distinguished into groups of a rank intermediate between genera and orders, which are variously termed *suborders* or *tribes*.*

Classes are groups of orders, having certain important characters in common. *Subclasses* bear the same relation to classes, that suborders do to orders.

By this regular subordination of groups, various degrees of relationship among plants may be expressed; and upon this systematic botany essentially depends. Only four of these divisions are universally employed, viz., *Classes*, *Orders*, *Genera*, and *Species*: these are common to all methods of classification, and are always arranged in the same sequence. But a more elaborate analysis is often requisite, on account of the large number of objects to be arranged, and the various degrees of affinity to be expressed; when the additional members, and if need be several others, are introduced; as in the following descending series:

Classes,
 Subclasses,
 Orders,
 Suborders,
 Tribes,
 Subtribes,
 Genera,
 Subgenera,
 Species.

An enumeration of the distinguishing marks, or points of difference, between one class or or-

* When the groups which an order embraces, are distinguished by characters of nearly equal value with those commonly employed for orders themselves, they are termed *suborders*. Thus, the plum, cherry, apricot, peach, &c., form one suborder of *Rosaceæ*; the raspberry, blackberry, strawberry, cinquefoil, with the rose and other genera, constitute another suborder; and the apple, the quince, thorn, &c., a third. The name of *tribe* is applied to groups comprised in a suborder (thus the rose constitutes a separate tribe from the raspberry, strawberry, &c.), or to the primary divisions of an order, when they are not founded on characters of high importance. In a loose and popular sense, the name of *tribe* is frequently used as if synonymous with that of order or family. Thus we say, The pea-tribe, the fir-tribe, the violet-tribe, &c., merely as a simpler expression for "The family of which the pea, &c., is a representative."

der, &c., and the others, is termed its *character*. The characters of the classes, and other primary divisions, embrace only those important points of structure upon which they are constituted: the *ordinal character* describes the general structure of the included plants, especially of their flowers and fruit: the *generic character* points out the particular modifications of the ordinal structure in a given genus; and the *specific character*, those less important modifications of form, relative size, colour, &c., which serve to distinguish kindred species. A complete system of botany will therefore comprise a methodical distribution of plants according to their organization, with their characters arranged in proper subordination; so that the investigation of a particular species will bring to view, not only its name (which separately considered is of little importance), but also its floral structure, affinities, and whole natural history. Such a system must of course be *natural*; that is, the groups, of whatever rank, must be composed of plants more closely related to each other than to any different groups, and so arranged that each shall stand, as far as practicable, next to those which it most nearly resembles in structure. These conditions are so far fulfilled by the *Natural system* (which, sketched by the master-hand of Jussieu, and augmented by succeeding botanists, is now generally adopted), as to render it on the whole far the readiest, as well as the only philosophical and satisfactory mode of acquiring any considerable amount of botanical knowledge; notwithstanding its manifold imperfections, and peculiar difficulties. But the relationships of plants, even when appreciated by botanists, could not be made available for the purpose of classification, until just views prevailed in vegetable organography and physiology, which constitute the very foundation of systematic botany, but which have only recently been placed upon a philosophical basis. Hence the immortal Linnæus, finding it impossible in his day to characterize the natural groups which his practised eye detected, proposed, as a temporary substitute, the elegant artificial scheme which bears his name. As this system is identified with the history of the science, which in its time it so greatly promoted, and as most systematic works have until recently been arranged upon its plan, it is still necessary for the student to understand it. Fortunately, its principles are so simple that a brief space will amply suffice for its explanation.

Of the Artificial System of Linnæus.—The object proposed by this system is merely to furnish an easy mode of ascertaining the names of plants; their relationships being left out of view, except that the species of a genus are always kept together, whether or not they all accord with the class or order under which they are placed. Its lower divisions, therefore, viz. the genera and species, are the same as in a natural system. But the genera are arranged in artificial classes and orders, founded on some single technical character, and have no necessary agreement in any other respect. Hence they may be likened to

words alphabetically arranged in a dictionary, where those which stand next each other have, it may be, nothing in common beyond the initial letter. The classes and orders are entirely founded upon the number, situation, and connexion of the stamens and pistils; the office and importance of which Linnæus had just established.

The classes, twenty-four in number, are founded upon modifications of the stamens, and have names of Greek derivation expressive of their character. The first eleven comprises all plants with perfect flowers, and a definite number of equal and unconnected stamens: they are distinguished by the absolute number of these organs, and are designated by names compounded of Greek numerals and the word *andria*, which is used metaphorically for stamen; as follows:—

Class 1. **MONANDRIA**, includes all such plants with one stamen to the flower.

2. **DIANDRIA**, those with two stamens.
3. **TRIANDRIA**, with three stamens.
4. **TETRANDRIA**, with four stamens.
5. **PENTANDRIA**, with five stamens.
6. **HEXANDRIA**, with six stamens.
7. **HEPTANDRIA**, with seven stamens.
8. **OCTANDRIA**, with eight stamens.
9. **ENNEANDRIA**, with nine stamens.
10. **DECANDRIA**, with ten stamens.
11. **DODECANDRIA**, with twelve to nineteen stamens.

The two succeeding classes include plants with perfect flowers, having twenty or more unconnected stamens, which in

12. **ICOSANDRIA**, are inserted on the calyx; (perigynous); and in

13. **POLYANDRIA**, on the receptacle (hypogynous).

Their essential characters are not designated by their names; the former merely denoting that the stamens are twenty in number; the latter that they are numerous.

The two following depend upon the relative length of the stamens, viz.,

14. **DIDYNAMIA**, including those with two long and two short stamens; and
15. **TETRADYNAMIA**, those with four long and two short stamens.

Their names are Greek derivatives, signifying in the former that two stamens, and in the latter that four stamens are most powerful.

The four succeeding are founded on the connexion of the stamens:

16. **MONADELPHIA** (meaning a single fraternity), with the filaments united into a single set, tube, or column.
17. **DIADELPHIA** (two fraternities), with the filaments united in two sets or parcels.
18. **POLYDELPHIA** (many fraternities), with the filaments united in more than two sets or parcels.
19. **SYNGENESIA** (from Greek words signifying to grow together), with the anthers united into a ring or tube.

The next class, as its name denotes, is founded on the union of the stamens to the style:

20. **GYNANDRIA**, with the stamens and styles consolidated.

In the three following, the stamens and pistils are separated: thus,

21. **MONŒCIA** (one household), includes plants where the stamens and pistils are in separate flowers on the same individual.
22. **DIOŒCIA** (two households), where they occupy separate flowers on different individuals.
23. **POLYGAMIA**, where the stamens and pistils are separate in some flowers and united in others, either on the same or two or three different plants.

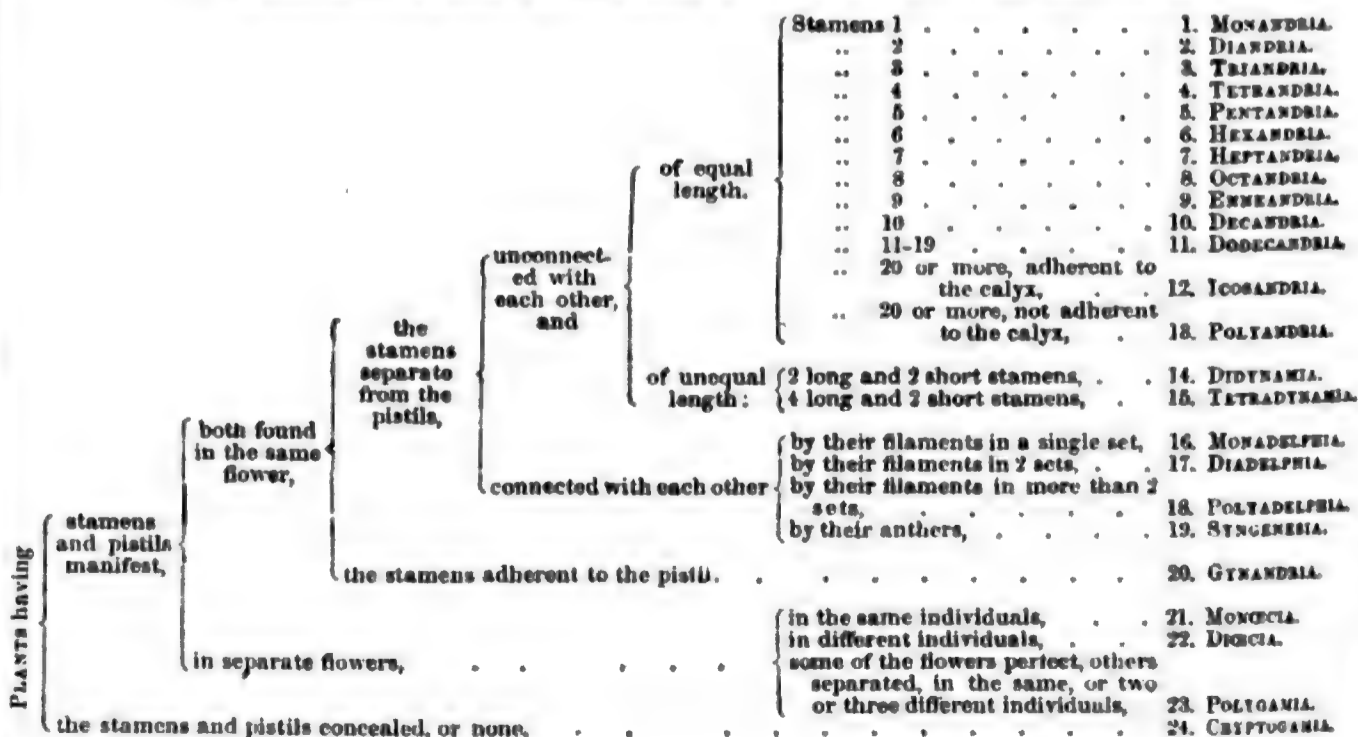
The remaining class,

24. **CRYPTOGAMIA**, is said to have concealed stamens and pistils (as the name imports), includes what are commonly termed Flowerless plants.*

The orders, in the first thirteen classes of the Linnæan artificial system, depend on the number of styles, or of the stigmas when the styles are wanting; and are named by Greek numerals prefixed to the word *gynia*, used metaphorically for pistil, as follows:—

- Order 1. **MONOGYNIA**, embraces all plants of any of the first 13 classes with one style to each flower.
2. **DIOGYNIA**, embraces those with two styles.
3. **TRIOGYNIA**, those with three styles.
4. **TETRAGYNIA**, those with four styles.
5. **PENTAGYNIA**, those with five styles.
6. **HEXAGYNIA**, those with six styles.
7. **HEPTAGYNIA**, those with seven styles.
8. **OCTOGYNIA**, those with eight styles.

* The character of the classes may be presented at a single view, as in the subjoined analysis:



9. ENNEAGYNIA, those with nine styles.
10. DECAGYNIA, those with ten styles.
11. DODECAGYNIA, those with eleven or twelve styles.
12. POLYGYNIA, those with more than twelve styles.

The orders of class 14, Didynamia, are only two; viz.,

1. GYMNOSPERMIA, meaning seeds naked, the achenia-like fruits having been taken for naked seeds.
2. ANGIOSPERMIA, with the seeds evidently in a seed-vessel or pericarp.

The 15th class, Tetradynamia, is also divided into two orders, which are distinguished by the mere form of the pod:—

1. SILICULOSA; the fruit a silicle, or short pod.
2. SILIQUOSA; fruit a silique, or more or less elongated pod.

The orders of 16th, 17th, 18th, 20th, 21st, and 22d classes, depend merely on the number of stamens; that is, on the characters of the first 13 classes, whose names they likewise bear: thus,

Order 1. MONANDRIA; 2. DIANDRIA; and so on.

The orders of the 19th class, Syngenesia, are six, viz.,

1. POLYGAMIA ÆQUALIS, where the flowers are in heads and all perfect.
2. POLYGAMIA SUPERFLUA, the same as the last except that the rays, or marginal flowers of the head, are pistillate only.
3. POLYGAMIA FRUSTRANEA, those with the marginal flowers neutral, the others perfect.
4. POLYGAMIA NECESSARIA, where the marginal flowers are pistillate and fertile, and the central (those of the disk) staminate and sterile.
5. POLYGAMIA SEGREGATA; where each flower of the head has its own proper involucre.
6. MONOGAMIA, where solitary flowers (that is, not united into a head) have united anthers, as in *Lobelia*. This order was abolished by succeeding botanists, but upon very insufficient grounds.

The 23d class, Polygamia, has three orders, founded on the characters of the two preceding classes, viz.,

1. MONÆCIA, where both separated and perfect flowers are found in the same individual.
2. DIÆCIA, where the different flowers occupy different individuals.
3. TRIÆCIA, where one individual bears the perfect, another the staminate, and a third the pistillate flowers.

The orders of the 24th class, Cryptogamia, are natural, and therefore indefinable by a single character. They are

1. FILICES, the Ferns.
2. MUSCI, the Mosses.
3. ALGÆ, which, as left by Linnæus, comprised the Hepaticæ, Lichens, &c., as well as the Sea-weeds.
4. FUNGI, Mushrooms, &c.

Of the natural system.—The object proposed by the natural system of botany, is to bring together into groups those plants which most nearly resemble each other, not in a single and perhaps unimportant point (as in an artificial classification), but in all essential particulars; and to combine the subordinate groups into larger natural assemblages, and these into still more comprehensive divisions, so as to embrace the whole vegetable kingdom in a methodical arrangement. All the characters which plants present, that is, all the points of agreement or difference,

are employed in their classification; those which are common to the greatest number of plants being used for the primary grand divisions; those less comprehensive for subordinate groups, &c.; so that the *character* or description of each group, when fully given, actually expresses all the known particulars in which the plants it embraces agree among themselves, and differ from other groups of the same rank. This complete analysis being carried through the system, from the primary divisions down to the species, it is evident that the study of a single plant of each group will give a correct (so far as it goes), and often a sufficient idea of the structure, habits, and even the sensible properties of the whole.

What we call a natural method, it may here be remarked, is so termed merely because it expresses the natural relationship of plants, as far as practicable; for every form yet contrived, or likely to be devised, is to a considerable extent artificial: 1st, Because the affinities of a particular group cannot be fully estimated until all its members are known; and thus the progress of discovery leads to changes, or modifies our views, as in every other department of knowledge. 2d, Because the boundaries of groups are not so arbitrarily circumscribed in nature, as they necessarily are in our classifications; but individuals depart from the assigned limits in various directions (like rays from a centre); the “edge of difference being as it were softened down by an easy transition.” 3d, Because that, even supposing the groups to be perfectly natural, and their affinities completely understood, it is impossible to arrange them in a single continuous series, in such a manner that each shall be preceded and followed by its nearest allies; since the same family, for instance, may be about equally related to three or four others, only two of which points, at best, can be indicated in the lineal series which must be adopted in books. And 4th, We are still obliged to use avowedly artificial characters, for the sake of convenience; as in the arrangement of the numerous orders of Exogenous plants into the Polypetalous, Monopetalous, and Apetalous divisions, although different genera of the same order, or different species of the same genus, may present these very diversities.

In explaining the general principles of classification, we proceeded from the species to the class; showing how groups of successive rank arise from the consideration of points of agreement. In applying them to the actual distribution of plants according to the generally received mode of classification, it will be more convenient to pursue the analytical course, and to show how the vegetable kingdom, taken as a whole, is divided and subdivided by regarding the points of difference. Plants in general are composed of several kinds of elementary tissue; such as cells, fibres, and vessels, so arranged as to form an axis, which elongates in opposite directions, and bears distinct and regularly arranged appendages; some of which (leaves) are organs of nutrition, while others form flowers, and serve for the production of seed; that is, of bodies containing an embryo capable of development into a similar plant. The varied forms are all evidently referable to this common type. But there are vegetables of a lower grade; in which this general plan is not only modified, but changed,—gradually indeed, for Nature presents no abrupt transitions, but so essentially that, in the most reduced forms, no trace of the original type remains. The first index of this change of plan, is the disappearance of flowers; their place being supplied by apparatus, no doubt of analogous nature as well as office, but of structure irreconcilable to the former type. Hence the obvious and primary division of the vegetable kingdom into two great series, the *Flowering* and the *Flowerless plants*.

If our attention were first directed to the anatomical structure and manner of growth, instead of the

mode of reproduction in these plants of lower grade, we might have drawn the line of demarcation somewhat differently. For, while the higher flowerless plants, such as the equisetums, the club-mosses, and ferns, do not essentially differ from the lower flowering plants in the structure and composition of their stems, &c., consisting as they do of all the kinds of elementary tissue (except perhaps the laticiferous), the mosses, and all below them in the series, are wholly composed of cellular tissue. If we were to make this distinction the basis of classification, as proposed by De Candolle, we should have two primary divisions in the form of *Vascular and Cellular plants*; the latter comprising the mosses, hepaticæ, lichens, sea-weeds, and fungi, which are entirely composed of cellular tissue, as well as flowerless. But another, and perhaps more natural division may be effected still lower in the series. For the mosses, although cellular, agree with the orders of higher grade in having regular stems, which grow upwards by means of buds, and are symmetrically clothed with distinct leaves: while the lichens, sea-weeds, and fungi, the most imperfect of vegetables, present no distinction into stem, root, and leaves, no polarity, or growth in two opposite directions, no buds, and no organs which are even analogous to flowers. Their homogeneous tissue often tends to the formation of flat, more or less definite expansions, which is the nearest approach to any thing like leaves; in which their spores, mere vesicles or little masses of cellular tissue, are embedded. Hence they are termed *Thallophytes*. If the line of primary division be drawn in view of these important distinctions, as proposed by Unger and Endlicher, the vegetable kingdom will be separated into two great, but unequal series, viz., 1st, the *Cormophytes*, or *Stem-growing plants*,—those with a distinct axis of growth, elongating downwards into roots, and upwards by means of buds into stems, provided with leaves, and with reproductive organs analogous to flowers; and 2d, the *Thallophytes*, which are stemless, rootless, leafless, and in every sense flowerless. But it will perhaps be found more convenient to retain the equally natural primary division into *Flowering and Flowerless plants*, as already proposed; which are synonymous with the older, and not very objectionable names of *Phænogamous*, or *Phanerogamous*, and *Cryptogamous plants*.

In this view, the series of Flowerless plants will naturally subdivide into two classes; the first embracing those with a stem, or distinct axis of growth, usually clothed with leaves; such as the ferns, club-mosses, mosses, &c.; which, as their stems usually grow by elongation from the apex solely, and have little or no provision for increase in diameter, have been termed *Acrogens*; that is, *point-growers*: the second comprising the Thallophytes above-mentioned, which exhibit no such distinction of parts, and which, for the sake of uniformity, may be called *Thallogens*.

The great series of Flowering or Phænogamous plants presents, as to the stem, two distinct kinds of structure and growth, the *Exogenous* and the *Endogenous*; leading at once to a division into two classes, viz., the *Exogens* or *Outside-growers*, and the *Endogens* or *Inside-growers*. The embryo of Exogens is provided with a pair of cotyledons, that of Endogens with only one; whence the former are also termed *Dicotyledonous*, and the latter *Monocotyledonous plants*,—names introduced by Jussieu, the father of this branch of botany. There are other marks, more or less characteristic of these two classes; particularly the netted-veined leaves of the former, which usually fall off by an articulation, and the parallel-veined or nerved leaves of the latter, which decay without falling.

There is, however, a group of Exogenous plants (of which the pines, firs, yew, &c., are representatives), belonging to the lower end of the series,

which differs from all the rest in having the ovules and seeds naked, instead of enclosed in an ovary or pericarp; and, as a set of spurious Endogenous plants (the cycas and zamia) accord with them in this remarkable particular, they are together deemed to form a third, although much smaller class, with the name of *Gymnospermous* (that is, *Naked-seeded plants*, or *Gymnosperms*).

There is still another small group of very strange parasitic plants, which seem to form a connecting link between Endogens and the lowest grade of Flowerless plants, or Thallogens; inasmuch as they are almost wholly composed of cellular tissue, and, although producing flowers, and those too, in one instance (that of the far-famed *Rafflesia*), of immense size, yet their ovaries are filled with spores instead of seeds. Hence they are considered to form the fourth and lowest class of Flowering plants, and have been named *Rhizanthæa* or *Root-flowering plants*, as well as *Sporogens*, in allusion to their singular peculiarity.

These four classes of Flowering plants may therefore be characterized as follows:—

- Class I. EXOGENS, or DICOTYLEDONS. Structure of the stem exogenous. Seeds in a pericarp. Embryo with two cotyledons.—Leaves netted-veined.
- Class II. GYMNOSPERMS. Seeds naked. Embryo with two or more cotyledons.
- Class III. ENDOGENS, or MONOCOTYLEDONS. Structure of the stem endogenous. Seeds in a pericarp. Embryo with a single cotyledon. Leaves usually parallel-veined.
- Class IV. RHIZANTHS, or SPOROGENS. Structure mostly cellular. Pericarp containing spores instead of seeds.—Embryo none.—Parasites.

The two classes of Flowerless plants being added, the mutual relationship of the whole may be completely expressed by disposing them, as it were, circularly, in the following manner:—

Exogens	Endogens
Gymnosperms	Sporogens
Acrogens	Thallogens

The Gymnospermous plants being nearly related on the one hand to Exogens or the highest Flowering plants, and on the other to the Acrogens or highest Flowerless plants, as will hereafter more fully appear; while the Sporogens are equally allied to the Endogens or lowest class of Flowering plants, and to the Thallogens or lowest Flowerless plants. The student will remark the impossibility of arranging even these six classes in a lineal series, so that each shall stand between the two to which it is particularly related. Thus, if the order be, 1. Exogens, 2. Gymnosperms, 3. Endogens, 4. Sporogens, 5. Acrogens, 6. Thallogens (which is the consecutive series from the highest to the lowest grade), we fail to indicate the alliance of Gymnosperms to Acrogens, and of Sporogens to Thallogens. If the series be, 1. Exogens, 2. Endogens, 3. Sporogens, 4. Gymnosperms, 5. Acrogens, 6. Thallogens; the Sporogens are still widely separated from the Thallogens, while they are brought next to the Gymnosperms, to which they are not allied; and two classes intervene between the latter and Exogens: similar obstacles stand in the way of any other lineal disposition.

The leading characters of all the classes may also be analytically expressed in the following manner:—

		Embryo	Class.
furnished with flowers, and	producing seeds in a pericarp.	Embryo dicotyledonous; the growth exogenous	EXOGENA.
		Embryo Monocotyledonous; the growth endogenous	ENDOGENA.
	producing naked seeds		GYMNOSPERMA.
destitute of flowers,	producing spores instead of seeds		SPOROGENA.
	but with regular stems, growing from the apex, and furnished with leaves		ACROGENA.
	and with no distinction of stem and leaves, or regular axis of growth		THALLOGENA.

These six classes are very unequal, in respect to the number of plants they embrace: the Exogenous class containing many more species as well as orders than all the other Flowering plants put together; the Endogens also comprising numerous types; but the others very few in comparison. Convenience of analysis therefore requires that the larger classes should be broken up into subclasses, alliances, cohorts, or by whatever name groups intermediate between the classes and orders may be termed; and the accomplishment of this object, so as to form natural groups, is at present the great desideratum in systematic botany. But until this be done, we are obliged to use artificial analyses of the classes, or to throw the orders into groups which, in proportion as they are rendered natural, it becomes impossible strictly to circumscribe. In this view the great class of Exogenous plants is usually broken up into three very convenient, but nearly artificial divisions, sometimes called *subclasses*; founded on the presence, absence, or union of the petals, viz.,

1. **POLYPETALE**, the Polypetalous Exogens; where the calyx and corolla are both present, and the latter composed of distinct petals.
2. **MONOPETALE**, the Monopetalous Exogens, where the petals are united.
3. **APETALE**, the Apetalous Exogens, where the petals are wanting; and the floral envelopes, if present at all, consist of the calyx alone.

These divisions, as well as the other classes, are subdivided by different authors in various ways, which need not be specified; since it is only the classes and the orders that are considered to rest upon a stable basis.

The orders, or families, are to be viewed rather as natural groups of genera, than as subdivisions of the classes. Their names, which are always plural, sometimes express a characteristic feature of the group; as, for instance, *Leguminosæ*, or the Leguminous plants, such as the pea, bean, &c., whose fruit is a legume; *Umbelliferae*, or Umbelliferous plants, so named from having the flowers in umbels; *Compositæ*, an order having what were termed compound flowers by the earlier botanists; *Labiata*, so called from the labiate or two-lipped corolla which nearly all the species exhibit; *Cruciferae*, which have their four petals disposed somewhat in the form of a cross, &c. But more frequently, and indeed as a general rule, the name is formed from that of some leading or well-known genus, which is prolonged into the adjective termination *aceæ*. Thus, the plants of the order which comprises the mallow (*Malva*), are called *Malvaceæ*; that is, *Plantæ-malvaceæ*, or in English, Malvaceous plants; those of which the Rose (*Rosa*) is the well-known representative, are *Rosaceæ*, or Rosaceous plants, &c. This termination in *aceæ* being reserved for orders, should not be applied to sub-orders or tribes; which usually bear the name of their principal or best-known genus, in

an adjective form, without such prolongation. Thus the genus *Rosa* gives name to a particular tribe, *Rosææ*, of the order *Rosaceæ*; the genus *Malva* to the tribe *Malvææ* of the order *Malvaceæ*, &c.

The number of genera in an order is quite as indefinite as that of orders in a class, or other great division. While some orders are constituted of a single genus, as *Equisetaceæ*, *Grossulaceæ*, &c. (just as many genera contain but a single known species), others comprise a large number; nearly nine hundred being embraced in the last general enumeration of the *Compositæ*. The names of genera are Latin substantives, in the singular number, and mostly of Greek or Latin derivation. Those which were known to the ancients, generally preserve their classical appellations (Ex. *Fagus*, *Prunus*, *Myrtus*, *Viola*, &c.); and even the barbarous or vulgar names of plants are often adopted, when susceptible of a Latin termination, and not too uncouth; for example, *Thæa* and *Coffæa*, for the Tea and Coffee plants, *Bambusa* for the Bamboo, *Yucca*, *Negunda*, &c. But more commonly generic names are formed to express some botanical character, habit, or obvious peculiarity of the plants they designate; such as *Arenaria*, for a plant which grows in sandy places, *Dentaria*, for a plant with toothed roots, *Lunaria*, for one with moon-shaped pods, *Sanguinaria*, for the Blood-root, *Crassula*, for some plants with remarkably thick leaves. These are instances of Latin derivatives; but recourse is more commonly had to the Greek language, especially for generic names composed of two words, such as *Menispermum* or Moon-seed; *Lithospermum*, for a plant with stony seeds; *Melanthium*, for a genus whose flowers turn of a black or dusky colour; *Epidendrum*, for Orchideous plants which grow upon trees; *Liriodendron*, for a tree which bears lily-shaped flowers, &c. Genera are also dedicated to distinguished persons, a practice commenced by the ancients; as in the case of *Pæonia*, which bears the name Pæon, who is said to have employed the plant in medicine; and of *Adonis*, for the plant which is fabled to have arisen from the blood of the wounded Adonis; and *Euphorbia*, *Artemisia*, and *Asclepias*, are also examples of the kind. Modern names of this kind are given in commemoration of botanists, or of persons who have contributed to the advancement of natural history. *Magnolia*, *Bignonia*, *Lobelia*, and *Lonicera*, dedicated to Magnol, Bignon, Lobel, and Lonicer, are early instances of the practice; *Linnaea*, *Tournefortia*, *Jussiaea*, *Gronovia*, &c., bear the names of more celebrated botanists; and at the present day almost every devotee or patron of the science is thus commemorated.

The names of species, as a general rule, are adjectives, written after those of the genera, and established on similar principles; as *Magnolia grandiflora*, the Large-flowered magnolia; *M. macrophylla*, the Large-leaved magnolia; *Bignonia radicans*, the Rooting-bignonia, &c. The generic and specific names, taken together, constitute the proper scientific appellation of the plant. Specific names sometimes distinguish the country which a plant inhabits (Ex. *Viola Canadensis*, the Canadian violet), or the station where it naturally grows (as *V. palustris*, which grows in swamps, *V. arvensis*, in fields, &c.), or they express some obvious character of the species; as *V. rostrata*, where the corolla bears a remarkably long spur; *V. tricolor*, which has three-coloured flowers; *V. rotundifolia*, with rounded leaves; *V. lanceolata*, with lanceolate leaves; *V. pedata*, with pedately parted leaves; *V. primulaefolia*, where the leaves are compared to those of the Primrose; *V. asarifolia*, where they are likened to those of *Asarum*; *V. pubescens*, which is hairy throughout, &c. Frequently the species bears the name of its discoverer or describer, when it takes the genitive form, as *Viola Muhlenbergii*, *V. Nuttallii*, &c. When such

commemorative names are merely given in compliment to a botanist unconnected with the discovery or history of the plant, the adjective form is preferred; as *Carex Torreyana*, *C. Hookeriana*, &c.: but this rule is not universally followed. Specific names are sometimes substantive; as *Ranunculus Flammula*, *Hypericum Sarrothra*, *Linaria Cymbalaria*, &c.: when they do not necessarily accord with the genus in gender. These, as well as all specific names derived from those of persons or countries, should always be written with a capital initial letter.

HISTORY OF THE SCIENCE.—Of the two general divisions of botany, the physiological or philosophical is the elder. Before the Greek philosophers attempted to distinguish classes and species of plants, they examined the laws of vegetable life, the difference of plants from animals, and, as far as it could be done with the naked eye, their structure. Theophrastus of Eresus is the creator of philosophical botany, which he treated on a great and original plan. From the writings of the Alexandrians, and from original observations, Dioscorides of Anazarba, in the first century of the Christian era, compiled a work, which contains imperfect descriptions of about 1,200 plants, the medical qualities of which were more attended to by the author than the description of their characteristics or their philosophical classification. This work continued, for 15 centuries, the only source of botanical knowledge. The Persian and Arabian physicians added about 200 plants, which were unknown to the Greeks, and, consequently the number of known plants, at the time of the revival of letters, was about 1,400. Germany has the merit of having founded historical botany. The obvious imperfections of Dioscorides, when the plants of Germany came to be investigated, and the extravagances into which those persons fell who attempted to apply his descriptions to German plants, impelled Hieronymus of Brunswick, Otho Braunfelsius, Leon. Fuchs, Hieron. Tragus and Conrad Gesner, to examine the vegetable productions of their country, independently of Dioscorides, and to represent them in wood-cuts. Gesner first started the idea that the parts of fructification were the most essential, and that plants must be classified with reference to them. They were followed, in the 16th century, by the Italians, Peter Matthioli, Andr. Cæsalpinus, Prosp. Alpini and Fab. Columna; the Belgians, Dodonæus, Clusius, and Lobelius. Among the botanists of this period, who extended the science by their labours in collecting specimens, are the French Dalechamp, the English Gerard, the German Joach. Camerarius, Tabernæmontanus and John Bauhin, whose brother Gaspard not only increased the number of known plants by numerous discoveries, but endeavoured to reform the nomenclature, which had become much confused by the multiplication of names of the same plant. These are the fathers of botany, whose standard works still reward examination. By the exertions of these men, the number of known plants, at the beginning of the 17th century, amounted to 5,500.

The necessity of classification increased with the quantity of materials. Lobelius and John Bauhin adopted the natural division of trees, grasses, &c., without reference to any general principle. Andreas Cæsalpinus, by the advice of Conrad Gesner, fixed upon the fruit and the seed as the foundation of a classification, which is still retained by many of his followers, who are called *fructists*. In the 17th century, new methods were introduced by Robert Morison and John Ray; the latter of whom attended to the structure of the corolla and its parts, while Rivinus considered only the regularity or irregularity of its shape, and Tournefort its resemblance to other objects. The number of known plants was increased by Morison, Plukenet, Barrelier, Boccone, van Rhee, Petiver, and Plumier. In the 17th century, the foundation of botanical anatomy was laid by Grew and Malpighi; botanical chemistry was founded by Homberg, Dodart, and Mariotte; and the difference of sex was discovered by Grew, Morland, and Rud. Jak. Camerarius. This discovery Micheli attempted to extend even to the lower degrees of organization, moss, lichens, and sponges. To such predecessors, and to the great collectors of herbariums, Rumphius, Parkinson, Sloane, Flacourt, Sommeelyn, Buxbaum, Ammann and Feuillée, the immortal Linnæus was indebted in part for the idea on which his system was founded, and for his great stores of botanical knowledge. When the first edition of his '*Species Plantarum*' was published, he was acquainted with 7,300 species; in the second edition, with 8,800. If we consider that a moderate herbarium now contains from 11,000 to 12,000 species, we must be astonished at the increase in the number of known plants in 60 years. The two sexes of Linnæus were afterwards extended, by Dillenius, Schmidel, and Hedwig, to the imperfect vegetables. This system was opposed by Adanson, Alston, and Haller; it was extended still farther by Schreber, Scopoli, Crantz, and Jacquin. In the 18th century, numerous discoveries in the vegetable world were made by John Burmann, J. G. Gmelin, Pallas, Forskall, Forster, Hasselquist, Browne, Jacquin, Aublet, Sommerson, Stahl, Swartz, and Aiton. Vegetable physiology was enlarged and enriched with new discoveries by Bonnet, Duhamel, Hill, Koelreuter, and Senebier, and thus botany approached its present degree of improvement.

BOTHY. The apartment in a farmery, inhabited by unmarried ploughmen. It serves at once as kitchen, eating-room, and sleeping-room; and, both in its furniture and its character, possesses more resemblance to a barrack-room than to a proper domicile of farm-servants. Its inmates are usually all the unmarried ploughmen of the farm; every two of them have a bed and bed-clothes in the apartment; and the whole body cook for themselves, and live together almost as if they formed a bachelor establishment on an island inaccessible to the rest of their spe-

cies. All receive their chief wages in the form of a proper allowance of each kind of requisite provisions, fuel, and other necessities of life; and the several individuals receive separate amounts of money wages, proportioned to their real or reputed skill as ploughmen. The heartless bothy-system, as this mode of ploughman life is called, prevails somewhat extensively in some of the best farming districts of Scotland; and is certainly a most undesirable substitute for the good, old, cordial practice of treating unmarried ploughmen as servant-members of the farmer's family.

BOTRYTIS. A genus of minute parasitic fungi, forming the type of a subdivision of fungi called Botrytidei, and belonging to the tribe Coniomycetes. The other genera of the subdivision are four in number, but they comprise only about sixteen known species, and appear to have been imperfectly observed. The genus botrytis comprises about twenty known British species, and nearly as many known foreign species; it possesses considerable interest, in connexion with the habits of several of its species; and it has borrowed an additional but fictitious interest from a mistaken identification of it with mildew. Its spores, when seen through the microscope, appear to be clustered somewhat in the manner of grapes, and are alluded to in the name botrytis, which means a bunch of grapes. Two of the species, *diffusa* and *nigra*, are minutely conspicuous; but all the other species are strictly microscopic, or can be discriminated by the naked eye only as they are segregated in sheets or masses. The plants consist of little cells adhering end to end, one part lying prostrate on the vegetable substance to which they are attached; and another part rising erect, and bearing the spores on its extremity. *B. diffusa* grows on rotten herbaceous stems, has a white colour, and appears like broad tufts. *B. effusa* grows on the lower side of living leaves, has a purple-greyish colour, and appears like spots. *B. nigra* grows on rotten trunks, has a black colour, and appears like dusty powder. *B. leucosperma* grows on rotten pears, has a grey colour, and appears like woolly tufts. *B. lateritia* grows on hollow potatoes, has a brick-red colour, and appears like a thin patch. *B. infestans* has recently challenged attention, and acquired notoriety, from its prevalence on the potato crop. Most of the other species grow on decaying vegetables.

BOTS, BOTFLIES, OR GADFLIES,—scientifically *Cestridae*. A tribe of dipterous insects, well known to farmers for the annoyance which several of their species give to sheep, oxen, and horses. The perfect insects are short-lived, and seldom seen; and the larvæ spend most of their existence under the skin, within the stomach, or otherwise in the interior of ruminating animals. Yet the whole tribe, in all the stages of existence, is remarkable for extraordinary habits, nice mechanical adjustments, and a general character of wondrous instinct and beautiful organization. Two

genera particularly challenge the farmer's notice, *Gasterophilus* and *Cestrus*; and these differ from each other principally in the latter having transverse nervures towards the apex of the wings closing the cells, and in its wing-scales or wing-lets being so very large as to cover the whole of the halteres. The gasterophilus was constituted a separate genus by Dr. Leach; and it includes five British species, and possesses a bad pre-eminence for its constant and instinctive infesting of the horse. The antennæ are inserted in a cavity of the face; the eyes, in both sexes, are equally distant; the mouth is either a-wanting, or consists of an indistinct linear opening, without the usual appendages; the alimentary canal has no opening at the anterior extremity; and the posterior margin of the wings has no transverse nervures.

The great spotted horse-bot, *Gasterophilus equi*, is one of the largest and by far the most common, not only of the genus, but of the tribe. Its length is about seven lines; its general colour is clear yellowish-brown; its head is broad and obtuse; its thorax has a somewhat greyish colour; its abdomen is rusty brown, with a tinge of yellow, and a series of dorsal spots; and its wings are whitish, with a black undulated transverse fascia behind the middle. The female, in a series of sudden descents or dartings, deposits her eggs upon the hair of some part of the horse, within reach of his mouth, making them instantly adhere by means of a glutinous secretion which she gives out along with them, and sometimes depositing upon a single horse so many as four hundred or five hundred eggs. Each egg is somewhat conical in shape, the attached end forming the apex; and, when seen through a magnifying glass, is shagreened on the surface with transverse and longitudinal striæ. The horse, in licking himself, takes up a considerable proportion of the eggs with his tongue; the eggs disclose their animated contents either while on the tongue, or very speedily after passing into the stomach; and the larvæ immediately attach themselves to the stomach's inner tissue, and there remain in security, from the end of summer or beginning of autumn, till late in spring, enjoying a temperature of about 102° of Fahrenheit, suffering no injury from the action of the gastric juices, feeding upon the mucus or the chyme, and gradually though slowly growing to maturity of size. Each larva is shaped somewhat like a flask or elongated bag; it has a pale yellowish colour; it possesses at the sides of its mouth two hooks, with which it anchors itself to the stomach's membrane; and it is engirdled with several belts or rings of spinelets and projecting points, by means of which it regains its position when, at any time, it accidentally loses its hold. When it attains maturity, it disengages itself from its anchorage, is carried with the horse's food into the villous portion of the stomach, passes out of it with the chyme, and is

evacuated with the dung. The ejected maggot seeks a place of shelter, buries itself in the ground, and contracts and changes into a chrysalis; the insect, in this latter form, resembles the larva in shape, but is more rigid, and has a reddish-brown colour; and, after lying for a few weeks inactive, it escapes by the narrow end of the pupa-case, and assumes its final form of an imago or a fly.

Many stern opinions have been entertained as to excessive injuries done to the horse by the great common bot which we have described, and as to the desirableness of using strong medicinal means for destroying the insect; but all such opinions, in the matured judgment of modern farriers, are very nearly without foundation. "The bots," says Mr. Youatt, "cannot, while they inhabit the stomach of the horse, give the animal any pain, for they have fastened on the cuticular and insensible coat. They cannot stimulate the stomach and increase its digestive power, for they are not on the digestive portion of the stomach. They cannot, by their roughness, assist the trituration or rubbing down of the food, for no such office is performed in that part of the stomach—the food is softened, not rubbed down. They cannot be injurious to the horse, for he enjoys the most perfect health when the cuticular part of his stomach is filled with them, and their presence is not even suspected until they appear at the anus. They cannot be removed by medicine, because they are not in that part of the stomach to which medicine is usually conveyed; and if they were, their mouths are too deeply buried in the mucus for any medicine, that can safely be administered, to affect them; and, last of all, in due course of time they detach themselves and come away. Therefore, the wise man will leave them to themselves, or content himself with picking them off when they collect under the tail and annoy the animal." Yet the consequences to the horse, and through him to man, might have been very disastrous if those protecting laws to which Mr. Youatt refers had not been established by the infinitely wise Creator of animals and of animal instincts, or even if very powerful checks had not been placed in constant operation upon the multiplication of the insects. "It is fortunate," remarks Mr. Clark, "for the animals infested by these insects, or rather most beautifully ordained, that their numbers are much reduced, and kept within due limits, by the hazards they are exposed to in the singular round of their propagation." Some of the eggs, in the very act of their deposition, are shaken off by the movements of the horse; some, though firmly deposited, are not taken up by the horse, or are externally hatched from the action of rain or other moisture, and in consequence perish; many are destroyed during the horse's process of mastication; many fail to make a lodgment in the stomach, but pass on to the intestines; and not a few of the matured larvæ are

dropped in such situations as to be crushed by the horse's foot, picked up by birds, or unable to find a suitable retreat for their transmutation into chrysalides. Altogether, one hundred or upwards perish in the state of either egg or larva, for every individual which attains the perfect condition of the fly.

The red-tailed horse-bot, *Gasterophilus hamorrhoidalis*, also infests the horse, but in a different manner from the great spotted horse-bot, and is not much more than one-half of the size of that fly. Its forehead is white; its eyes are brown; its thorax is black in the centre, brownish on the sides, and thinly pubescent; its abdomen is white at the base, black in the middle, and reddish-yellow at the extremity; its legs are pale; and its wings are unspotted. Its eggs somewhat resemble those of the great spotted horse-bot, but are so elongated at the apex as to have the appearance of standing upon footstalks; and they are attached, not to the hairs of the horse, but to his lips. The horse suffers great annoyance from the deposition of the eggs, and offers it an angry resistance. Whenever a fly approaches his lips, he tosses his head, gallops away if he can, and dashes his tormentor, if possible, into water; and, when an egg is deposited upon him, he shows great agitation, rubs his mouth against the ground or upon his forelegs, and frequently makes outward strokes with his forefoot. The larvæ are smaller, rounder, and proportionally longer than those of the great spotted horse-bot; and they attach themselves, in exactly the same manner, to the membrane of the stomach; but, before making their exit from the intestines, they attach themselves for a considerable time to the rectum, and there occasion the horse so great uneasiness as to make him often kick, and sometimes to render his movements awkward.—Three other species of gasterophili—designated *nasalis*, *salutiferus*, and *Clarkii*—occur in Britain, but are so comparatively rare as not to challenge description.

The ox-bot, *Estrus bovis*, is a very annoying insect; and, as its name implies, it usually infests animals of the ox species. It is about the same size as the great spotted horse-bot, or rather larger; its forehead is white, and densely hairy; its thorax is yellow in front, black in the middle, and ash-coloured behind; its abdomen has an apex with tawny-yellow hairs, and a black fascia in the middle, and is ash-coloured at the base; its wing-scales are white and very large; and its legs are black and tarsi pale. Its eggs are deposited either on the skin, or in oviposital perforation through it; and its larvæ grow beneath the skin, principally along the sides of the ox's spine, and occasionally on his loins, and cause tumours or abscesses analogous to the galls on the leaves of willows and other trees, but often as large as pigeons' eggs. When cattle are attacked by the fly, they frequently become furious, bellowing with violence, and running off at their

utmost speed, with extended tail and outstretched neck; and if attacked when yoked to the plough, they instantly become so unmanageable that many ploughs used to be provided with a contrivance for giving them immediate liberation. A herd of cattle when almost driven home have been struck with such terror by meeting an ox-bot, that they instantly wheeled about, ran off in a brisk retreat, and defied the shouts, sticks, and stones of their drivers, till they found protection in a pond of water; and frequently a team of oxen, when attacked at their work in the field by a bot, and not instantly liberated by means of the contrivance to which we have referred, have fled with the plough at their heels, totally regardless of both their driver and the enormous encumbrance upon their flight. The larva of the ox-bot has an oblong-oval shape; it consists of eleven segments formed by transverse bands, which are crossed at the sides by longitudinal lines; and it has, on each side of every segment, a distinct spiracle or breathing-hole. A cyst or minute cell within the substance of the skin is the abode of the young larva, and the commencement of the abscess or tumour; this gradually enlarges with the growth of the larva; a secretion of pus, occasioned by the local irritation, supplies the insect with food; and a minute opening on the crown of the tumour, permits the insect to place the extremity of its principal air-tube in contact with the atmosphere, and afterwards, at the season of maturity, to withdraw its whole body from the tumour. A curious and very beautiful instinct incites every larva, when about to become a chrysalis, to withdraw from its nidus, neither during the night when it would perish before it could get a place of refuge, nor during the heat of the day when it would be destroyed by the intensity of the sun's rays, but exactly at the time of the morning when temperature and other circumstances are most suitable to its condition. In its earlier stages of existence, the larva is white like that of most other flies; in the later stages, it darkens in colour till it becomes almost black; and, on its passing into the pupa-state, it is transmuted into so rigid a chrysalis, that the fly, when perfected, escapes from it only through a wonderful contrivance in its formation, resembling, in microscopic miniature, the lid of a snuff-box.

The tumours occasioned in the skin of cattle by the ox-bot have long been popularly regarded as a disease under the name of warbles, wormals, or womils; and in the years 1823 and 1824, they were so exceedingly numerous and virulent upon the cattle of the department of Loiret in France, as to occasion fever, inflammation, and death. Except in rare instances, however, warbles do not affect the healthy condition of cattle, but, on the contrary, are regarded by butchers as indications of soundness and strength. Yet hides which have been affected with warbles are irretrievably damaged, and are readily and greatly

depreciated by the tanner; the tortures, too, which cattle suffer at the deposition of the eggs, are injurious to their welfare, and sometimes occasion considerable accidents; and, for these reasons, efforts ought to be made, in every district, to exterminate or at least keep down the bot. Either the insertion of a red-hot needle, or the application of a little corrosive liquor, or squeezing out and crushing with the finger and thumb, will kill the larvæ; and if all the farmers of a district would examine their cattle and destroy the larvæ, warbles would speedily become very rare. Yet Linnæus, Bracy Clark, and other eminent naturalists, contend—on principles which certainly harmonize well with the general laws of utility and beneficence which govern all the works of the all-wise Creator—that all kinds of bots, instead of being on the whole pernicious, are positively beneficial to the general health of the animals which they infest.

The sheep-bot, *Oestrus ovis*, is the only other species which we require to notice. Its length is scarcely five lines; its forehead has a dusky-red colour, with a blackish depression; its antennæ are black; its thorax is ash-grey, with numerous small, black, hairy warts; its abdomen is a variegated silky-white and light-yellow; its legs are pale red; its wings are clear and unspotted; and its wing-scales are white and large. The eggs are supposed to be deposited on the margin of the nostrils of the sheep; and the deposition of them appears either to inflict or to occasion much pain,—and at all events is greatly dreaded by sheep, and attempted to be warded off by various methods of defence. Sheep, when attacked, in dry hot weather, run into public roads, lie down upon the dusty ruts, and hold their heads close to the ground; or they continue to stand, and place their nose between their fore-legs almost in contact with the ground; or, in an open field, they rush together into a dense assemblage, and so push their noses together or hold them to the ground, that only those on the outskirts of the flock remain accessible to the fly. The larvæ are soon hatched by the heat and moisture of the nostrils; they speedily effect a lodgment in the frontal maxillary and in other cavities of the face; they feed upon the pus which their irritating presence occasions to be secreted; and when they become full-grown, they drop through the nostrils, and seek an asylum of transformation into a pupa state, beneath some loose soil or in adhesion to a blade of grass.—*Clark's Essay on Bots.*—*Westwood's Entomology.*—*Papers of Mr. Duncan in Quarterly Journal of Agriculture.*—*Youatt on the Horse.*—*Cattle, in Library of Useful Knowledge.*—*Bartlett's Farriery.*—*White's Veterinary.*

BOTTOM HEAT. The heat maintained in brick pits by the fermentation of tanner's bark, oak-leaves, stable-litter, or other vegetable matter. It maintains a temperature of from 60° to 90°, and has long been used by gardeners for

growing pine-apples, cucumbers, melons, and a great diversity of tropical plants. It came into use when the heating of hothouses could not be effected by any other known means but such as dried the air, and were altogether unsuited to succulent vegetables; but it has been rendered wholly unnecessary by the modern methods of heating by means of steam and hot water pipes; and it continues to be used only where heating is not required on any considerable scale, or where ignorance and prejudice resist the triumphs of scientific improvement. See the article **BARK-BED**.

BOUDS. Weevils which breed in malt and grain. But the name is quite provincial.

BOUND. The constipation or constriction of an animal. A horse or any other animal suffering constipation in the bowels is popularly said to be bound; and when subjected to other kinds of unnatural constriction, he is said to be hide-bound, hoof-bound, &c.

BOUVARDIA. A genus of splendidly-flowering, evergreen, undershrubs, of the madder tribe. The three-leaved species, *B. triphylla*, was brought to Great Britain from Mexico in 1794, and has hitherto engrossed more attention than any other species; but it includes two other varieties, *pubescens* and *glabra*. Both varieties usually grow to the height of about 2½ feet, and produce brilliant scarlet trumpet-shaped flowers, and may be so treated, by alternation of winter dormancy in the greenhouse and stimulating summer culture in the open air, as to bloom from April till the commencement of severe frost. Yet they have as vigorous a growth and offer as stout a resistance to frost as *Fuschia coccinea*, and may be kept in fine condition in the open air, simply by being cut down late in autumn, and having their roots and the base of their stem protected by leaves or litter during winter. They can readily be propagated by cuttings of their roots, in strong soil, in fruiting pine-pots, in a hothouse temperature of between 60° and 70°. They have deservedly challenged general favour as among the most beautiful of our small flowering shrubs. Two other species, the various-coloured and the long-flowered, *versicolor* and *longiflora*, have been more recently introduced; and the latter of these is peculiarly handsome, but has less hardiness than the other species.

BOVEY COAL. A brown coal or lignite found in England, and named from the place of its occurrence.

BOWELS. The intestines of an animal. They occupy a chief part of the abdomen, and serve important and complicated purposes in the animal economy; and in both their structure and their functions, they require to be well studied by physiologists and farriers. The diseases of the bowels are various, and, in one or two instances, virulent, and often fatal. But they will be noticed in the articles **INFLAMMATION**, **ENTERITIS**, **COLIC**, **ENTANGLEMENT**, **INTROSUSCEPTION**,

WORMS, **STONE**, **HERNIA**, **DIARRHŒA**, **DYSENTERY**, AND **CONSTIPATION**.

BOWER. A large umbrageous seat in a garden, shrubbery, or park. It may be square, semicircular, or of other form below, but is usually more or less dome-shaped above; and it may consist either of a simple bench overhung by the interlaced branches of trees, or of elegant cabinet-work, enclosed within a cage or trellis of intertwined climbing shrubs, and tastefully trained festoons.

BOWS OF A SADDLE. Two pieces of wood laid archwise to fit the upper part of the horse's back, and to give the saddle its proper form, and keep it steady.

BOX. A vessel for containing any dry material,—usually a square wooden vessel with a lid, for holding or packing any articles which are not liquid. But few English words have more numerous and conflicting meanings, whether classical, colloquial, or technical. Some wooden vessels, as chests and trunks, are not boxes; some boxes, as those for carrying snuff in the pocket, are not wooden vessels; many kinds of boxes, as the box of a stage coach, the box of a wheel, the box of a plough, and the box of a bridge, are properly not vessels at all; and some figurative boxes, such as blows and difficulties, have no conceivable analogy to literal boxes. The box of a wheel is the cavity in which the axis turns; and the box of a plough is the cross piece which supports the two crow-staves. For the plant box, see the article **Box-TREE**.

BOX-CHURN. See **CHURN**.

BOX DRAIN. A drain so built that a vertical section of it has the same outline as that of a box. Its sides are upright; and its cover is flat. See the article **DRAINING**.

BOX-ELDER,—botanically *Negundo*. A genus of ornamental timber trees, of the maple tribe. They were formerly classed as maples, under the designations of *Acer negundo* and *Acer fraxinifolium*; but they are readily distinguishable from all true maples by the resemblance of their leaves to those of the ash-tree. The American or ash-leaved species, *Negundo Americanum* or *Negundo fraxinifolium*, was introduced to Great Britain from North America in 1688. It usually attains a height of about 35 or 40 feet; and its leaves have a pale green colour, and give an agreeable variety of tint to a mixture of park trees; but its branches, in any exposed situation, are liable to be split and broken by the winds. Its timber serves the same purposes as that of the sycamore maple. This tree may be propagated from either layers, cuttings, or keys. A well established variety of it is called the curled box-elder,—*N. f. crispum*. Two other species are known to botanists.

BOX-THORN,—botanically *Lycium*. A genus of ornamental shrubs, of the nightshade family. Nearly twenty species have been introduced to Great Britain from the Cape of Good Hope, China,

North America, Peru, Barbary, Siberia, and the south of Europe; and about ten other species are known to botanists. One of the introduced species, the African, is a small deciduous tree; three, the rigid, the fleshy, and the small-leaved, are deciduous shrubs; six, the slender, the tetrandrous, the ashy, the horrid, the Carolina, and the Boerhaavia-leaved, are evergreen shrubs; one, Shaw's, is an evergreen climber; and the others are deciduous climbers. The evergreen climber and three of the evergreen shrubs are half-tender; and all the rest are quite hardy. We shall particularly notice only two as specimens of the whole.

The Barbary box-thorn, *Lycium Barbarum*, is a native of various countries of Africa, Asia, and Europe, and was introduced to Great Britain from Barbary in 1696. It is a deciduous climber, and usually attains a height of about 12 or 16 feet; but it has such rambling habits that, if let alone for a few years, it will overspread everything in its vicinity. Its branches are very numerous, exceedingly spreading, so rapid in growth as to shoot 12 or 16 feet in a single season, and so stoloniferous that, if allowed to trail upon the ground, they will strike root and send up a whole crop of young shoots. The branches are covered with a grey or whitish bark; the leaves have a thick consistence, and a light whitish green colour,—grow by threes on all sides of the branches,—and are oval spear-shaped, very smooth, a little glossy, and often do not fall till the middle of winter; large spines, of a foot or more in length, and garnished with single, alternate leaves, cover the stem and the older branches, and many short, sharp, whitish spines stand near the ends of the shoots; and the flowers are small, have a purplish or violet colour, grow singly on short footstalks at the joints, and appear from May till August, or even bloom in a succession till the commencement of severe frost.

Shaw's box-thorn, *Lycium Shawii*, was introduced from the Cape of Good Hope in 1700. It is a half-tender climbing evergreen, and usually attains a height of about 8 or 9 feet. It has a low shrubby appearance; its branches rise upward from the ground, and are covered with a dark green bark, and armed with strong, short, binate thorns; its leaves are heart-shaped, not much larger than those of the box-tree, of the same consistence and colour, terminating in acute points, and standing on short footstalks, in opposite pairs; and its flowers are small, white, and odoriferous, stand in groups of five or six on short slender footstalks, and appear in July and August. This plant is preserved through the winter under a common frame; and is propagated from cuttings.

BOX-TREE,—botanically *Buxus*. A genus of hardy evergreen shrubs, of the spurge tribe. The common box, *Buxus sempervirens*, is at once exceedingly well-known, eminently beautiful, and very variously useful. It grows wild on some of

the chalk hills of England, and in most parts of Europe, but attains its greatest size near the shores of the Mediterranean. Extensive plantations of it were made, by the Earl of Arundel, at Boxhill in Surrey; and the clearings of these plantations in the year 1815 produced upwards of £10,000. Woods and groves of it appear to have formerly existed in several districts of England; and had they not been swept away by uncalculating operations in georgy, they would probably have, at this day, been more profitable than any other possible produce of the soil. The box-tree flourishes on very poor soils and in bleak situations, and is there far more worthy of the planter's notice than any known ligneous plant cultivated in Great Britain; and even on the best soils and in the choicest situations, it would probably make as remunerating a return as any other tree except the oak, the ash, the elm, and the beech. The plantations of it at Boxhill were long ago as remarkable for their thriving condition as for their extent; yet the soil is a poor, thin-skinned, chalky loam, and the situation is high, unsheltered, and singularly churlish. The box-tree thrives alike in poor soil and in rich, in an open district and amidst choking shelter; and so remarkably patient is it of the shade and drip of other trees, that it may occasionally be seen as healthful and luxuriant in a neglected grove or under a perfect canopy of foliage as on the breezy summit of an unsheltered hillock. It might be most advantageously raised as underwood to the oak, and form an admirable cover to game. It has long and most deservedly held a prominent place among the ornaments of the shrubbery; and while one of the most common, is not the least handsome, of our dendritic evergreens. Its deep and glossy verdure, its small, neat, profuse foliage, the swelling softness of its outline, and the richness and delicacy of its general appearance, render it both grateful and attractive during the leafless period of deciduous trees.

The timber of the box-tree is yellowish, close grained, very heavy, and very hard, cuts much better than other wood, takes a very fine polish, is exceedingly durable, and sells in the market for a very high price. It is the timber used in wood-engraving; it is used much in turnery, and very extensively in the manufacture of musical and mathematical instruments; it is employed in France for making combs, knife-handles, and other small articles; and it has of late years come into such increased demand in England as to be a considerable article of exportation from the Mediterranean. The value of English boxwood in 1785 was 16s. per cwt.; and that of Turkey boxwood, during the last few years, has been from £7 to £14 per ton.—Boxwood, according to a statement made by M. Du Petit Thouars to the Philomathic Society of Paris, is more extensively used than hops by the Parisian brewers; and it probably owes its successful substitution of hops to its containing a powerful chemical principle,

of a bitter taste and sudorific properties, now known to chemists under the name of buxinia. It was formerly used instead of guaiacum, as a sudorific in rheumatism; but is now seldom or never prescribed. An oil obtainable from the root was formerly used as a remedy for toothache; but was superseded first partially by other essential oils and by pungent tinctures, and next wholly by creosote. Olivier de Serres recommends the leaves and branches of boxwood as by far the best manure for the vine, both because it is very common in some vinous countries, and because it yields by decay an unparalleledly large quantity of vegetable mould.

Though the common box is regarded as but one species, it comprises several permanent and rather widely different varieties, and also an undetermined number of subvarieties or of fluctuating and slightly defined varieties. The broad-leaved common box may be regarded as the normal *Buxus sempervirens*; and, as its name implies, is characterized by the breadth and largeness of its leaves. It assumes a tree-like character, and, though usually attaining a height of only about 8 feet, it rises, under good culture, to the height of 15 or 20 feet. Its branches have a yellowish hue; and its leaves are smooth and shining, and grow in naturally opposite pairs.—The narrow-leaved box, *Buxus angustifolia*, comprises several subvarieties, which differ from one another chiefly in the size of their leaves. The smallest-leaved subvariety may be viewed as the normal one; and this is of rather lower growth, and has more numerous and slender branches, than the broad-leaved box. It naturally forms itself into a regular head, and assumes an air of slenderness and delicacy. Its leaves are very small and narrow, not so shining as those of the broad-leaved box, but far more numerous.—The variegated box comprises two distinct subvarieties, the gold-striped and the silver-striped. These are usually regarded as mere variegations of the broad-leaved box; but they differ from it, not only in the stripedness of their leaves, but also in their manner of growth, and in the delicacy of their configuration. Though quite as tall as the common box, their branches are weaker and more slender, and, in many instances, assume a pendulous character, while those of the common box are always straight and upright. Both the variegation of the leaves, and the greater delicacy of conformation, render these subvarieties particular favourites in shrubberies and mixed gardens.—The gold-edged variety considerably resembles the broad-leaved in robustness and general outline; its branches are strong and upright, and have a less green or more yellowish bark than those of the broad-leaved box; and its leaves are tipped or edged with yellow.—The curl-leaved striped box takes its name from the circumstance of its leaves being a little waved. It is both a distinct and a rare variety, has a rather lower growth than the broad-leaved box, acquires a

luscious appearance from the curliness and variegation of its leaves, and has justly been pronounced pleasing, truly beautiful, and very elegant.—The dwarf or subshrubby box, *Buxus sempervirens suffruticosa*, is the universally known variety which forms so exquisite and so generally used an edging for garden beds and borders. It is simply but unconquerably distinguished by its mere dwarfishness; for it seldom attains a height of more than about 12 or 15 inches, and cannot, by any known application of culture, be either forced or coaxed out of its dwarfish habit.

The balearic box, *Buxus balearica*, grows wild in the islands and on the shores of the Mediterranean, and was introduced to Great Britain from Minorca in 1780. It attains about the same height as the normal variety of the common box, but differs considerably from it in appearance. Its timber is coarser and of a brighter yellow colour than that of the common box; and is believed to constitute the inferior kinds of boxwood timber imported to England from Turkey.—The Chinese-box, *Buxus chinensis*, was introduced from China in 1802. It requires greenhouse protection, and never rises to one-half the height of the common box.—The southern box, *Buxus australis*, was introduced from New Holland in 1820. It also is a greenhouse plant, but it attains about double the height of the Chinese box.

The several species and the permanent varieties of box may be propagated from seeds; and when thus raised, and afterwards properly cultivated, will attain their maximum size. The seeds should be gathered when just ripe, and ready to burst out of their cells; and should, soon afterwards, be sown about half an inch deep, in a bed of light sandy earth. The young plants ought to appear next spring, but sometimes will not appear till next again; and, in the latter case, the seed-bed ought to be kept free from weeds, and to be gently watered in dry weather. Young plants require also to be occasionally watered during the summer after they come up; and they ought to remain two or three years in the seed-bed before being removed to the nursery.—All the kinds of box except the dwarf may be propagated from cuttings. The cuttings ought to be about a foot in length, of one year and two years wood,—if possible slips of one year with knees of two years; they ought to be inserted half their length in the ground, at distances of four inches from one another; and they may be planted during any moist open weather of winter, but succeed best when planted immediately after the first autumnal rains. They ought to stand till about the third year, to be transplanted to the nursery during any open weather between August and April, and to be placed in nursery rows at two feet from row to row and one foot from plant to plant.—Many plants of most kinds of box propagate themselves by layering; for whether borne down by the weight of their own foliage, or overpowered by a fall and lodgment of snow, they

strike root from almost all their branches which lie in contact with the ground. This natural layering may of course be artificially imitated.—The dwarf box is propagated from its suckers. But the process of its propagation is so very easy and so generally known that it needs not to be described.

BOXWOOD. See **BOX-TREE**.

BOYENING. The letting of cows' milk to a professed milkman. The boyener, as the milkman is called, pays a stipulated sum annually to the farmer for each boyened cow, and has the whole responsibility and charge of drawing and disposing of the milk; and the farmer provides him with lodging and implements, and gives all requisite pasturage, fodder, and housing to the cows. This curious practice is not uncommon in Ayrshire; and takes its name from the word boyn, which signifies a milk-pail.

BRABEJUM. See **AFRICAN ALMOND**.

BRACE. A pair or couple of bucks, hounds, partridges, or other animals; also, a piece of timber or iron framed into a part of a building, or of any other structure, to support or strengthen it.

BRACHYPODIUM. A genus of grasses, with terminal spikes, somewhat like those of wheat. Three species grow wild in Great Britain; twelve species have been introduced from the south of Europe; one, from Tauria; three, from Germany; three, from respectively France, Barbary, and Mexico; and four or five more are known to botanists. The winged species, *Brachypodium pinnatum*, formerly called *Bromus pinnatus*, is a perennial weed of the heaths of Britain, attains a height of about three feet, and flowers from June till August. The wood species, *Brachypodium sylvaticum*, formerly called *Bromus sylvaticus*, is a perennial weed of the hedges of Britain, attains a height of about two feet, and flowers from June till August. The loliaceous species, *Brachypodium loliaceum*, formerly called *Triticum loliaceum*, is an annual weed of the sea-coasts of Britain, attains a height of about one foot, and flowers in June and July. Most of the introduced species are quite destitute of interest; eight or nine of them are very dwarfish; and two, *B. Halleri* and *B. tenuiculm*, are curious annuals. Specimens of the winged, the wood, and the two-spiked species—the last a perennial of about a foot in height from the south of Europe—are preserved in the museum of the Highland Society. The name *Brachypodium* is compounded of two Greek words which signify 'a short foot.'

BRACKEN. See **BRAKE** and **FERN**.

BRACT, or BRACTEA. A floral leaf on the axis or footstalk of a flower. In many instances, it is situated on the stem of the footstalk, at its axis or base, and appears to the eye as if giving it mechanical support; in other instances, as in all the nigellæ and some of the hellebori, it is situated so near the flower as to be distinguishable from a calyx chiefly by its enduring as long as many of the common leaves, while a calyx

fades at the decay of the flower or the maturing of the fruit; and in a few instances, it is situated either on the calyx itself, as in several species of muscenda, or even on the fruit, as in several varieties of the pear. The bract of most plants is shaped like a leaf, though not always like a leaf of its own plant; and that of others is shaped like respectively a calyx, a scale, a thorn, and a flask. In most plants, it is green; in some, it is tinged with various shades and tints; in the lime tree, it is a pale yellow; in *Salvia Horminum*, it is a fine purple; and in *Bartsia Coccinea*, it is a brilliant scarlet.

BRAIN. The brain is a soft substance, partly reddish-grey and partly whitish, situated in the skull, penetrated by numerous veins, and invested by several membranes. Democritus and Anaxagoras dissected this organ almost 3,000 years ago. Haller, Vicq d'Azir, and other anatomists in modern times, have also dissected and investigated it without exhausting the subject. Between the skull and the substance of the brain three membranes are found. The outer one is called the *dura mater*. This is strong, dense, and elastic. It invests and supports the brain. The next which occurs is the *tunica arachnoidea*. This is of a pale white colour, yet in some degree transparent, very thin, and, in a healthy state, exhibits no appearance of vessels. The membrane below this is called the *pia mater*. It covers the whole surface of the brain. It is very vascular, and a great portion of the blood which the brain receives is spread out upon its surface in minute vessels. The brain consists of two principal parts, connected by delicate veins and fibres. The larger portion, the *cerebrum*, occupies, in men, the upper part of the head, and is seven or eight times larger than the other, the *cerebellum*, lying behind and below it. It rests on the bones which form the cavities of the eyes, the bottom of the skull and the *tentorium*, and projects behind over the *cerebellum*. On the whole exterior of the *cerebrum* there are convolutions, resembling the windings of the small intestines. The external reddish substance of the brain is soft and vascular, and is called the *cortical* substance; the internal is white, and is called the *medullary* substance of the brain. This *medulla* consists of fibres, which are very different in different parts. The *cerebellum* lies below the *cerebrum*, in a peculiar cavity of the skull. By examining the surface, it is seen to be divided into a right and left lobe, by the spinal marrow lying between, but connected at the top and bottom. Like the *cerebrum*, it is surrounded by a vascular membrane, reddish-grey on the outside, and composed of a medullary substance within. In proportion to its size, also, it has a more extensive surface, and more of the vascular membrane, than the *cerebrum*. In a horizontal section of it, we find parallel curved portions of the cortical and the medullary substances alternating with each other. Between the cortical and the medullary sub-

stance, there is always found, in the *cerebellum*, a third intermediate yellow substance. All the *medulla* of the *cerebellum* is also united in the middle by a thick cord. Experience teaches that, in the structure of the brain, irregularities are far more uncommon than in other parts of the human body. It is worthy of observation, that every part of the brain is exactly symmetrical with the part opposite. Even those which lie in the middle, and are apparently single (the spinal marrow, for instance) consist, in fact, of two symmetrical portions.

The total weight of the human brain is estimated at two or three pounds. It is larger and heavier in proportion to the youth of the subject; and in old age it becomes specifically lighter. In delirious affections, it is sometimes harder and sometimes less solid and softer.

The proportion which the size of the brain bears to that of the entire body, varies greatly for different mammalia. Even in the same individual it will change with the degree of fatness, or with the age of the animal. As these circumstances cannot be supposed to affect the powers of the mind very materially, we may naturally inquire how the relative size of the brain, and of the entire body, can be assumed as the measure of intelligence in an animal. To enable the student to form his own conclusions on this subject, we annex the following table, showing the proportion that the size of the whole body bears to that of the brain in several animals:—

The Squirrel monkey (<i>Callithrix sciureus</i>)	as 22 to 1
Capuchin monkey (<i>Cebus capucinus</i>)	... 25 ... 1
Striated monkey (<i>Jacchus vulgaris</i>)	... 28 ... 1
Field mouse (<i>Arvicola vulgaris</i>)	... 31 ... 1
MAN, according as he is	
young or old	as 22, 25, 30 and 36 ... 1
The Mole (<i>Talpa Europæa</i>)	as 35 ... 1
Coaita monkey (<i>Ateles paniscus</i>)	... 41 ... 1
Mouse (<i>Mus musculus</i>)	... 43 ... 1
Varied monkey (<i>Cercopithecus mona</i>)	... 44 ... 1
Gibbon (<i>Hylobates lar</i>)	... 48 ... 1
Collared Mangabey monkey (<i>Cercopithecus Æthiops</i>)	... 48 ... 1
Rat (<i>Mus decumanus</i>)	... 76 ... 1
Ruffed Lemur (<i>Lemur Macaco</i>)	... 84 ... 1
Porpoise (<i>Delphinus phocæna</i>)	... 93 ... 1
Great bat (<i>Vespertilio Noctula</i>)	... 96 ... 1
Dolphin (<i>Delphinus delphis</i>)	as 25, 36, 66, and 102 ... 1
Great baboon (<i>Papio Maimon</i>)	as 104 ... 1
Barbary ape (<i>Inuus magotus</i>)	... 105 ... 1
Ferret (<i>Mustela furo</i>)	... 138 ... 1
Rabbit (<i>Lepus cuniculus</i>)	as 140, and 152 ... 1
Cat (<i>Felis catus</i>)	as 82, 94, and 156 ... 1
Hedgehog (<i>Erinaceus Europæus</i>)	as 168 ... 1
Fox (<i>Canis vulpes</i>)	... 205 ... 1
Calf (<i>Bos taurus junior</i>)	... 219 ... 1
Hare (<i>Lepus timidus</i>)	... 228 ... 1
Wolf (<i>Canis lupus</i>)	... 230 ... 1
Panther (<i>Felis pardus</i>)	... 247 ... 1
Ass (<i>Equus asinus</i>)	... 254 ... 1
Bear (<i>Ursus arctos</i>)	... 265 ... 1
Beaver (<i>Castor fiber</i>)	... 290 ... 1
Sheep (<i>Ovis aries</i>)	as 192, and 351 ... 1
Marten (<i>Viverra martes</i>)	as 365 ... 1
Dog (<i>Canis familiaris</i>)	as 47, 50, 57, 154, 161 and 365 ... 1

Horse (<i>Equus caballus</i>)	as 400 to 1
Domestic hog (<i>Sus scropha</i>)	... 412 ... 1
Elephant (<i>Elephas Indicus</i>)	... 500 ... 1
Wild boar (<i>Sus scropha</i>)	... 672 ... 1
Ox (<i>Bos taurus</i>)	... 860 ... 1

From the above table it would appear that the brain is proportionably largest in the smaller animals. Man is surpassed in this respect only by a small number of mammalia, and these are lean and meagre. The rodentia generally possess the largest proportional brain, and the pachydermata the smallest. It is very difficult, if not impossible, to arrive at these results with any great degree of accuracy, because the weight of the brain generally remains the same, while that of the body will vary considerably according as an animal is lean or fat.

The proportion which the cerebrum bears to the cerebellum is, in

The Squirrel monkey (<i>Callithrix sciureus</i>)	as 14 to 1
Man	... 9 ... 1
The ox (<i>Bos taurus</i>)	... 9 ... 1
Dog (<i>Canis familiaris</i>)	... 8 ... 1
Wild boar (<i>Sus scropha</i>)	... 7 ... 1
Horse (<i>Equus caballus</i>)	... 7 ... 1
Cat (<i>Felis catus</i>)	... 6 ... 1
Hare (<i>Lepus timidus</i>)	... 6 ... 1
Sheep (<i>Ovis aries</i>)	... 5 ... 1
Mouse (<i>Mus musculus</i>)	... 2 ... 1

"It is a common opinion," observes Dr. Herbert Mayo, "that the front of the brain is the seat of the intellectual faculties; yet in monkeys and in man the back part of the brain is that which has the largest relative size. The sheep, on the other hand, has an ample front to its brain, a large intellectual region, according to the phrenological theory, while its instinct of attachment to its young has a poor locality in its moderate posterior cerebral lobe. Has nothing then been discovered to mark an essential superiority in the brain of man? The question must, I believe, be answered in the negative. No physical condition, distinguishing the human brain from that of animals, and therefore fitting it to co-operate with a rational soul, has as yet been ascertained, or even plausibly conjectured to exist." Physiologists have been led, in all ages, by that marked superiority of mental power which man possesses above the other animals, to seek in the structure of their brains for some corresponding difference. It was long supposed that man has the largest brain in comparison to his body; but the above tables show that he is surpassed by several quadrumana, and by the mouse.

There is another point of comparison which seems to approach nearer to their actual comparative intelligence, which was first proposed by Sömmering. By comparing the quantity of the brain with that of the nerves arising from it, we ascertain more accurately the degree in which its purer intelligence excels its mere animal nature. "Let us divide the brain into two parts;

that which is immediately connected with the sensorial extremities of the nerves, which receives the impressions, and is therefore devoted to the purposes of animal existence. The second division will include the rest of the brain, which may be considered as connecting the functions of the nerves with the faculties of the mind. In proportion, then, as any animal possesses a larger share of the latter and more noble part—that is, in proportion as the organ of reflexion exceeds that of the external senses—may we expect to find the powers of the mind more vigorous and more clearly developed. In this point of view, Man is decidedly pre-eminent; here he excels all other animals which have hitherto been investigated." Sömmering found that the brain of man never weighed less than 2 lbs. 5½ oz., while that of the horse never exceeded 1 lb. 4 oz. in weight. But the nerves arising from the brain of the horse were at least ten times larger than those in man. However ingenious this theory may be, it is not found to hold good in every instance; and even if proved, it would still leave the nature of the union between mind and matter as mysterious and as incomprehensible as ever. The nerves of the mammalia bear a striking resemblance in their disposition to those of man, with the exception of the olfactory nerves, which are large and hollow processes of the anterior lobes of the cerebrum, the cavities of which communicate with the lateral ventricles of the brain.

BRAIRD. The spring of annual or other herbaceous plants. When the unfolding plumules or first leaves of sown crops are vigorous and promising, they form what is technically called a good braird.

BRAKE,—botanically *Pteris*. A large genus of beautiful ferns. Most are evergreen; and many are cultivated in our hothouses for their singular elegance. One is a native of Great Britain; about forty have been introduced from foreign countries,—ranging from Siberia to New Zealand; about 130 have been scientifically described; and a considerable number which were formerly included in the genus are now distributed among the genera *Tænitis*, *Nothochlaena*, *Allosorus*, *Lonchitis*, and *Cheilanthes*. The aquiline or native British species, *Pteris aquilina*, grows in great abundance in the heathy wastes of most parts of Britain, and is well known to almost all our rural population under the names of bracken and breckin. Its root is perennial, long, tapering, creeping, and outwardly black; its fronds are annual, more than triplicately pinnated, from one foot to six feet in height, but usually about three feet, with horizontal, spreading, light-green, smooth-ribbed branches; and its main stem is sharply angular, and wounds the hand which suddenly or firmly grasps it. This plant is often greatly damaged by severe spring frosts; and it cannot bear to be transplanted. The peasantry of many districts, residing near wastes or hilly commons where it abounds, cut it down in large quantities, and

make very profitable use of it as litter in their cottage piggeries. One of the introduced, ornamental, hothouse species, has simple fronds; three have divided fronds; nine or ten have pinnate fronds; ten or eleven have bipinnate fronds; and most of the others have a general conformation and appearance similar to those of our indigenous species. The name *pteris* signifies a wing, and alludes to the winged appearance of the greater portion of the genus.

BRAKE. A herbaceous thicket, or wildly luxuriant portion of a common, a heath, or a glade. It is properly a place of the brake,—the fern described in the preceding article; but the name is, by accommodation, applied to every spot of similar character to that of a rank growth of brakes.

BRAKES. Tools and implements of very various kinds, used either in husbandry or in some of the arts connected with it. The common brake is a large and heavy common harrow, used for the reduction of stubborn and adhesive soils. The levelling-brake, the revolving-brake, Wilkie's-brake, and some other brakes for the pulverizing of soils, are either harrows, or grubbers, or compounds of the two, and will come to be noticed in the articles **HARROWS** and **GRUBBER**. A brake in machinery is a constraining wheel divided into joints, which, when necessary, stops another wheel that revolves within it. A flax-brake is a wooden toothed instrument for so bruising the stem of flax or hemp as to separate its cortical parts from its interior fibres. The brake of a pump is the handle with which it is worked. A smith's brake is an instrument for restraining refractory horses while they are being shod. See **BARNACLES**. A bridle brake is a sharp bit or snaffle.

BRAMBLE,—botanically *Rubus*. A large genus of plants of the dryas division of the rose tribe. Fifteen species, besides numerous varieties, grow wild in Great Britain; about forty species have been introduced from nearly all the great countries of the world, between Labrador and Siberia on the north, and New Holland on the south; and upwards of sixty other species have been scientifically described. Nine or ten of the introduced species are evergreen shrubs, of various ranges of tenderness from the stove to the mere frame; eight of the introduced and three of the indigenous species are upright deciduous shrubs; two of the introduced species are greenhouse evergreen, trailing shrubs; two of the introduced and two of the native species are perennial-rooted herbaceous plants; and all the other species growing in Great Britain are hardy deciduous trailers. The greater number have palmate leaves; six have simply lobed leaves; and ten have pinnate leaves,—some with smooth and others with woolly under-surfaces.

The common bramble, *Rubus fruticosus*, is a prickly trailing shrub, almost as well known as the common hawthorn. It grows wild in many

situations, but particularly in hedges and neglected commons, in almost all parts of Great Britain. The trailing stems usually attain a length of about ten feet; they are angular and channelled; they have a thickly set and powerful armature of strong, crooked, back-turned prickles; and, in winter, some are green in colour, others reddish-purple, and others partly green and partly red. The leaves are palmate,—some with three lobes, and others with five; their upper surface is smooth and beautifully green, and their under surface has a whitish colour. A series of prickles extends along the midrib of each lobe, and down the footstalk of each leaf; and they continue on the plants during most of the winter, yet become brown and fading after Christmas. The flowers have a pink colour, and appear from June till September; and the fruit is successively green, red, and black, and attains the last or ripened colour in the latter part of autumn.

The bramble, though abhorred by some farmers as a most troublesome weed, and despised by multitudes of the general population as an ill-looking, scratching, vulgar-fruited plant, serves beneficent purposes to the animated creation in waste parts of the country, and might readily be made subservient to some important economical purposes. When it abounds in any waste or neglected land which is proposed to be subjected to the plough, it ought to be grubbed or hoed up; and if thorough tillage speedily follow, it will soon be effectually destroyed. Bramble plants, mixed with hawthorns or almost any other kind of hedge-plants, thicken and strengthen their amassment in most descriptions of soil; and, when accompanied only with stakes or with what is usually termed a dead hedge, will speedily form a good fence in sandy soils of so poor a nature as to be totally unsuited to the growth of any of the ordinary hedge-plants. Yet two considerable objections occur,—first, that the leaves of the bramble are so large as to form a noxious shade over other plants,—and next that the shoots so speedily decay as to render a large proportion of an old bramble hedge dead wood. The long pliable branchy shoots may occasionally serve the purposes of a coarse cordage. The stems, leaves, and unripe fruit, when bruised together, and applied externally, have been regarded as a cure for ringworm. The roots, when lifted early in spring, and boiled with honey, have been pronounced a remedy for dropsy; and when dried in the shade, cut into small fragments, and used for the preparation of a weak infusion, they have been regarded as almost a specific against obstinate coughs. The fruit or berries are great favourites with country children; they are used in Provence for giving a deep colour to particular wines; and, in many districts of Britain, they are in great request for puddings, tarts, preserves, and British wines. "There is little doubt," says Billington, "but an excellent wine might be made from them alone,

or perhaps mixed with currants, both as a nutritive and medicinal beverage for poor or even rich people, much more cheap, wholesome, and grateful than the often adulterated and expensive foreign wines that are recommended by the faculty in such cases." An objection against the use of brambles in puddings or tarts, is that they highly discolour the lips and teeth; but the discoloration soon evanishes.

Nine varieties of the common bramble are known to be permanent, and have been recognised in systematic botany. The double-flowered variety, *R. f. plenus*, or *R. f. flore roseo pleno*, grows wild in the hedges of Britain, and has challenged not a little admiration for its floral beauty. Its double flowers are its only feature of difference from the normal common bramble; they are produced, like those of the latter, at the ends of the shoots, but are paler, exceedingly double, and not succeeded by any fruit; and as they usually flourish in great profusion, they make a remarkably beautiful and imposing show. A plant of this variety may be so pruned and confined in a garden as to have the appearance of a flowering shrub; and it will thrive and bloom under the drip of trees, or in situations where scarcely anything else of an ornamental kind will grow.—The white-fruited variety, *R. f. albus*, or *R. f. leucocarpus*, was first observed in a hedge in the vicinity of Oxford, but may occasionally be observed wild in hedges in many other parts of Britain. It has a lighter shade of green on both its stems and its leaves than the normal common bramble; yet it is principally distinguished by the whiteness of its fruit.—The unarmed or thornless variety, *R. f. inermis*, likewise grows wild in British hedges, and has often been regarded as a remarkable curiosity. Its shoots and branches are of a bluish colour, perfectly smooth, and more slender and trailing than those of the common variety; its leaves have a bluish tint; and its flowers have the same colour and are produced in the same manner as those of the common variety, but are not quite so large. But its grand peculiarity, and one which sometimes excites not a little surprise, is its perfect freedom from prickles.—The variegated-leaved variety, *R. f. foliis variegatis*, has striped leaves, is found only in gardens, is a weaker plant than the common variety, and affords some gratification to collectors of variegated shrubs.—The pompous variety, *R. f. pomponius*, is found only in gardens, and has whitish pink flowers.—The Taurian and the Dalmatian varieties, *R. f. tauricus* and *R. f. dalmaticus*, have respectively pinkish and rose-coloured flowers.—The glandulous and the one-coloured varieties, *R. f. glandulosus* and *R. f. concolor*, have pink flowers, and are natives of Germany.

Three of the best known and most valued British species, additional to the common bramble, are *Rubus idæus*, *Rubus cæsius*, and *Rubus chamæmorus*; but these will be noticed in articles on their English names, RASPBERRY, DEW-

BERRY, and CLOUDBERRY. The sub-upright species, *R. sub-erectus* or *R. nemorosus*, is a somewhat erect-growing shrub, occurs in the woods of Britain, usually attains a height of about 4 feet, has pinnate leaves, produces white flowers from June till September, and does not challenge attention for fruit.—The hazel-leaved, the folded, the similar, the white-spiked, and the buckthorn-leaved species, *B. corylifolius*, *plicatus*, *affinis*, *leucostachys*, and *rhamnifolius*, are all trailers of similar length and similar habit to the common bramble; but they produce white flowers, and possess the distinctive features indicated in their respective names, and do not yield any fruit worth notice.—The shining species, *R. nitidus*, is a small upright shrub of about 3 feet in height, grows wild in British thickets, and carries white blossoms from June till September.—The rock species, *R. saxatilis*, is a dwarfish trailer of but a few inches in length, grows wild in the moist woods of Britain, and carries white blossoms in June.—The arctic species, *R. arcticus*, is a dwarfish deciduous shrub, of only a few inches in height, grows wild on the rocky mountains of Scotland, produces pink flowers from May till August, and is sought after by the Highlanders for its fruit.

The bristly species, *R. hispida*, was introduced from Canada during the latter half of last century. It is a small, ornamental, ligneous trailer, of about 3 feet in length. Its shoots are rough and hairy; its leaves are trifoliatedly palmate, smooth, and serrated; the footstalks of both leaves and flowers are hispid; the flowers are white, and appear in July and August; and the fruit is round and red, and ripens in autumn.—The sweet-scented species, commonly called the flowering raspberry, *R. odoratus*, was introduced from North America in 1800. It is an ornamental upright shrub of 7 or 8 feet in height; it prefers a moist and shady situation; and it produces a reddish or pink-violet flower in June and July.—The occidental species, *R. occidentalis*, was introduced from North America before the close of the 17th century. It is an upright deciduous shrub, of about 5 feet in height, producing white flowers in May and June, and is valued for its fruit.—Four of the most recently introduced species are a trailer from Nepal, a trailer from North America, and two deciduous shrubs from respectively North America and Columbia.—*Billington on Planting*.—*Quarterly Journal of Agriculture*.—*Miller, Loudon, Marshall, Smith, and Phillips*.

BRAN. The skin or husks of corn, particularly of wheat, separated from the flour by the process of bolting. It operates, by mechanical irritation, as a very gentle aperient, merely quickening the passage of the contents of the intestinal canal; and when given in the form of a mash, and used with caution and moderation, it certainly is useful as an occasional aperient. But it ought, in no instance, whether in a raw or in a

scalded state, to be used constantly or as an article of diet; for if so used, it is apt to weaken a horse's bowels, and to excite in them many disorders. A very large proportion of ammoniacal phosphate of magnesia exists in wheat bran; and this salt forms large crystalline concretions, often amounting to several pounds in weight, in the cæcum of horses belonging to millers. "Mr. Ernes," says Youatt, "attended three mills at which many horses were kept; and there were always two or three cases of indigestion from the accumulation of bran or pollard in the large intestines." A little wheat bran, boiled in common beer, makes it mantle in the cup; and a little ammonia, mixed with beer, throws down ammoniated phosphate of magnesia in the form of a white precipitate. The ashes of wheat bran, according to the analysis of Saussure, comprise 44.15 per cent. of soluble salts, 46.5 of earthy phosphates, 0.5 of silica, and 0.25 of metallic oxides; and the remaining 8.5 per cent. were lost in the process. Bran is useful as dry food for sheep, and in the stall-feeding of black cattle; and an infusion of it is said to be a remedy for scurf and dandriff.—Bran itself is unquestionably one of the best materials for clearing mordanted goods, the branic acid probably acting by decomposing the mordant in places where it is not printed, and rendering it inert. It is superior to phosphate of soda by its brightening the colours, without loosening them, and its clearing a white ground more perfectly. As an addition to the dye-stuff, madder, log-wood, &c., it is equally efficient. With madder its action is striking; it prevents too much colour from adhering to the first piece dyed, and gives it a more fiery red by removing the brown tint, so that the second appears but a shade lighter than the first; in other words, it diffuses the colour and brightens it at the same time; the first piece passed through a bath precisely the same, but without bran, appears of a deep brownish red, the second is many shades lighter, and the third piece is a very light rose. The best proportion is 3 of bran to 1 of madder by weight, but this proportion must vary with the quality of the madder, and the object in view.

BRANCH. An arm or division of a tree or shrub, shooting out from the *caudex ascendens* of the plant, and assisting to form its head or crown. Its organic structure and physiological construction are the same as those of the stem. See the article **STEM**. In some plants, branches shoot only from the summit or upper extremity of the stem; and in others, they shoot also from its sides. In all the intricately headed or profusely ramified kinds of plants, the primary branches send off secondary ones, the secondary send off tertiary,—or all pass through successive subdivisions till they terminate in slender twigs and leaf-stalks, jointly constituting "spray." In their mutually relative positions, they are opposite, alternate, verticillate, or irregular; and in

their angle of deflection they are vertical, as when they go off at a very acute angle, and ascend close to the stem,—or spreading, as when they form a wide angle with the stem,—or horizontal, as when they shoot and grow nearly at right angles with the stem,—or pendulous, as when they arch and droop in the manner of the weeping ash, or the weeping willow.

But an orchardist or a forester looks on branches with a different eye, and classifies them in a different manner, from a botanist. Wood-branches are such large ones as are essential to the proper shape of the tree, and should be pruned from four to twelve inches, according to the degree of the tree's vigour. Fruit-branches are more slender than wood-branches, and have the eyes or foci of the fruit-buds near to one another and large; and if they be too long, they should be topped; but when they are of proper length, they should have no more cut off than the mere point which forms their extremity. Half-wood branches are of medium size between wood-branches and fruit-branches; and they ought to be cut off at the length of two or three inches, in order to induce a better shoot, whether for wood or for fruit. Irregular branches are small and confused; and being fit for neither wood nor fruit, ought to be entirely cut away. False wood-branches shoot from true wood-branches, and have flat and distant eyes; and, being useless for fruit and an incumbrance to the true wood-branches, they should be totally cut away. Luxuriant branches shoot from the large wood-branches, are long, tapering, and smooth, and have broad and mutually-distant eyes; and they also should be wholly cut away. Spurious wood-branches either do not shoot from the cuts of the preceding year, or are destitute of the proper form for becoming useful, mature branches, and ought likewise to be cut away. See the article PRUNING.

BRAND. A diseased condition in plants, presenting an appearance as if they had been burned. When drops of dew or of rain rest on leaves, and are evaporated by a sudden rise of temperature, but especially by a sudden and continued play of strong sunshine, the spots on which they lay lose their verdure, assume a yellow or darkish colour, and lose their power of exhaling moisture and fixing carbon. The drops of water seem to act jointly with heat and light, and probably with excited electricity, in destroying portions of the vegetable tissue; and when they occupy a large proportion of the surface, and lie on the bark as well as on the leaves, they sometimes occasion the utter ruin of plants. Brand occurs most frequently in the morning, when a twofold transition is taking place,—of the atmosphere, from darkness and cold to light and heat,—and of the plant, from its sleep disengagement of oxygen to its active absorption of carbonic acid; and it happens, not only by means of dew-drops and rain-drops in the open air, but by means of condensed vapour under the glass-covers of hot-beds. Skilful and

observing gardeners seem to have taken accurate practical note of its cause; for, before sunrise, they brush away the drops from their delicate plants. Popular opinion loosely ascribes brand, like smut and some other vegetable diseases, to some undefined atmospheric influence.

BRANDING, or BUISING. The stamping upon sheep of their owner's initials. One method is to burn in the initials with a hot iron,—and this is properly branding; and another is to stamp them on with an iron dipped in a boiling mixture of tar and pitch,—and this is properly buising. The branding-iron has the letters cut upon it in the form of a die, and requires to be made of prime iron in order to resist the effects of very frequent heating; and the buising-iron has the letters in a form of entire relief, and does not require to be made of the best iron.

BRANDY. An alcoholic liquid of some 50 per cent. strength, made by distilling wines. They are distinguished from each other by their peculiar flavour or aroma, arising in part from essential oil previously existing in the fruits from which they are derived, and in part from products generated by fermentation and distillation. Hence a good judge of brandy can determine from what place it is derived, in other words, from what fruit, and may even distinguish minute shades of difference in the quality of different brandies from the same source. In Germany and elsewhere, the term brandy (*Branntwein*, burnt wine) is applied to distilled liquors generally, derived from fermented grain, potatoes, grapes, and other fruit, but in the United States and in England it is usually restricted to distilled wines, or the distilled marc of the grape.

Among the ingredients in wines are sugar, gum, tartaric and acetic acids, free and combined, essential oils, extractive, &c. When they are distilled, an oily substance accompanies the alcohol, called *fousel oil*, which imparts a peculiar and usually disagreeable taste and odour to the liquor. This oil usually appears in greater quantity towards the end of a distillation, especially when a low temperature is employed, and hence may be obtained by distilling the residue after the alcoholic liquid is passed over. The fousel oil obtained by Aubergier was a clear liquid of a highly penetrating odour, a sharp and highly disagreeable taste, was soluble in 1,000 parts of water, and a single drop imparted the fousel taste to 15 gallons of well-flavoured brandy. Too little is known relative to this substance to remove it perfectly in the manufacture of brandy, and the probability is that fousel oil from different sources will prove very different in composition and properties. Cognac and other French brandies owe their agreeable flavour to the smaller amount and less disagreeable nature of their fousel oil, so that the proper aroma of the wine is clearly perceptible in their odour and taste. Oinanthic ether is another constituent which imparts an agreeable aroma to wines, and

passes into the brandy. In Cognac, &c., it is probable that the aromatic portion condenses sooner than a strong alcoholic liquid, for the finest kinds are only distilled to the spec. grav. 0·922 at the farthest, and by redistillation to procure a stronger liquor, much of the aroma is lost, or rather remains in the residue. The effect of heat on several of the substances noted above as constituents of wines, merits the attention of the distiller, for a little too high temperature, especially where the still is exposed to the direct action of the fire, is apt to generate empyreumatic and other products, which are unlikely to add to the quality of the liquor. To manufacture a brandy artificially, add to about 10 gallons of a pure alcoholic liquid, diluted much below the strength required, a pound of crude argol dissolved in water and a portion of good brandy, and distil the mixture with a gentle heat. Add to the distillate a little acetic ether and colour it with burned sugar. Astringency may be imparted by a few drops of tincture of catechu or pure tannic acid. The addition of brandy and crude argol introduces a portion of oinanthic ether, which, with the acetic ether, imparts the peculiar taste of genuine Cognac.

BRANK. See BUCKWHEAT.

BRASILETTO. See CÆSALPINIA.

BRASS. An alloy essentially composed of copper and zinc, often containing small quantities of iron, lead, and tin, either as accidental or designed ingredients. It was formerly made by igniting metallic copper with calcined calamine and charcoal. At present it is chiefly made by the direct fusion of the two metals, in consequence of the improved processes for obtaining zinc. The composition of good brass is about 2 parts copper to 1 part zinc, but the relative proportions of these two metals are varied, and small quantities of others are introduced, according to the destination of the brass. A little iron hardens it and diminishes its tenacity and malleability. We usually find traces of tin and lead in it, arising partly from solder in the old brass used in the manufacture, and the lead arising from a small quantity having been in the copper. Tin renders it harder and stiffer, and even a $\frac{1}{2}$ per cent. alters its ductility. The presence of lead renders it better adapted to the lathe, in consequence of the harshness it imparts to it. Pure brass without these metals is very ductile, may be easily drawn into thin wire, rolled, or extended by the hammer. A small quantity of zinc gives a reddish brass. The above formula gives a golden colour; a larger quantity of zinc produces a greenish yellow; and when the alloy contains more than half zinc, it is bluish grey. The density of the alloy is greater than the mean of that of its constituents.

Copper.	Zinc.	Observed density.	Calculated density.
70	30	8·443	8·390
80	20	8·940	8·560

Tempering diminishes its density, thus the

above of spec. grav. 8·94 after tempering was 8·92, another of density 8·344 became 8·250. The same operation also diminishes the tenacity and hardness of brass. The density increases in proportion to the copper, and may even equal that of copper itself, hence it varies between 8·2 and 8·95.

BRASSICA. A highly important genus of herbaceous plants, forming the type of a subdivision of the cruciferous family. The genera additional to itself comprised in this subdivision are *sinapis*, *moricaudia*, *diplotaxis*, and *eruca*. The brassica genus has entire stamens, undivided petals, an equal and slightly spreading calyx, a long, slender, and many-seeded pod, spherical seeds, and a radicle contained in the cavity of the folded cotyledons. Its chief species is the *oleracea*; and this, inclusive of its numerous varieties, is the subject of our articles CABBAGE, BORECOLE, KOHL-RABI, BROCCOLI, and CAULIFLOWER. Its species of next importance are *campestris*, *rapa*, and *napus*; and these are the subjects of our articles TURNIP and RAPE. Twenty-five species additional to these are grown in Great Britain; one of these, *B. monensis*, grows wild on the shores of the Isle of Man, and the others have been introduced from China, St. Helena, Minorca, and the continent of Europe; and nine or ten other species have been described by botanists. Two of the introduced species have silicles raised above the receptacle on short pedicels; and all the others, like the cabbages and the turnips, have sessile silicles. Six are perennials; nine are annuals; and all the rest are biennials. Only one, besides the turnips, *B. præcox*, is bulbous-rooted; and only this and the Chinese, *B. chinensis*, are cultivated for economical or practical purposes.

A serious mistake is still general, and till of late was universal, in Great Britain, as to the kinds of brassica which are most productive of the oils usually called rape and sweet oil. The *Brassica napus oleiferus* is the kind which British farmers have been accustomed to grow for oil; but the *Brassica campestris oleifera* is the kind which yields by far the largest produce. In Belgium, the latter kind is usually sown, about the middle of June, on a piece of well-manured garden ground; it is transplanted after harvest, into good-conditioned fields, which have been once ploughed after the removal of the corn; in November, it is cleaned and either top-dressed or watered with liquid manure; and it then stands over the winter, blossoms in spring, and soon afterwards runs to seed. "It would be desirable for agriculture," says De Candolle, "that, in all countries, cultivators would examine whether the plant they rear for oil is the *Brassica campestris oleifera*, or the *Brassica napus oleiferus*; which can easily be ascertained by observing whether the young plant is rough or smooth; if hispid, it is the *Brassica campestris*,—if glabrous, the *Brassica napus*. Experiments made by Gau-

jac show the produce of the first, compared to that of the second, to be as 955 to 700." The chief of the other plants cultivated for the extraction of oil from their seeds, are species of *sinapis*, *camelina*, and *raphanus*. *Sinapis alba* is cultivated in the Vosges under the names of *navet d'été* and *grain-de-beurre*. *Camelina sativa* is cultivated in some provinces under the same names as *Sinapis alba*; and, next to *Brassica campestris oleifera*, is the most productive of the oil-bearing cruciferous plants. *Raphanus sativus oleiferus* is a native of China, and is cultivated in Italy for its seeds. De Candolle says, respecting the whole group of the oil-bearing cruciferous plants, "Most of them, and perhaps the whole number, are susceptible of two different variations, the one having a thin, slender, slightly fleshy root,—the other a thick and fleshy root. In general, those of the first kind bear a considerable quantity of seeds, and are cultivated throughout Europe as oleiferous vegetables; the others, on the contrary, bring few seeds to perfection, and are cultivated in general for their roots, as excellent for field or garden vegetables. So in the *Brassica oleracea*, the varieties that have a thin stalk are cultivated for their seeds; and those that have swelled radicles are reserved for food. Among the varieties of the *Brassica campestris*, which, by reason of its large seeds, appears to be eminently oleiferous, the colsa is the most productive, and has the thinnest root; for the produce of the oil, the ruta-baga and common *Napus brassica* are much less useful. In the *Brassica rapa*, the navette with a thin root is cultivated for its oily seeds, whilst the turnip, or *Brassica rapa depressa*, is used for food. In the *Brassica napus*, the navette with a thin root is cultivated for its oil, and the navet for the sake of its root. Lastly, in the *Raphanus sativus*, the same circumstance again appears; the thin roots constantly belong to the many-seeded varieties, whilst the thick fleshy roots are employed for culinary purposes only.—A similar law may be observed in other cruciferous plants. The *Cochlearia armoracea*, which has a very large thick root, rarely brings any seeds to perfection, whilst every other species of *cochlearia* produces them freely. This observation may be useful to guide cultivators in the choice of the varieties proper to try as oleiferous plants. If taken in a more extensive sense, it may serve to throw some light on the laws of vegetation in general, for we know it is not confined to cruciferous plants alone."

The *Brassica oleracea* has the singular property of communicating fecundation to other species of brassica, and at the same time being incapable of receiving fecundation from any. Its pollen has been successfully applied, not only to other species of brassica, but even to the cultivated black radish; and it has itself resisted the pollen of all species of brassica, and of all varieties except its own. Even the colsa, chou-navet, or

white ruta-baga, *Brassica campestris napo-brassica*, and the navet-jaune or common yellow ruta-baga, *Brassica campestris napo-brassica ruta-baga*, which appear to be hybrids between *Brassica oleracea* and *Brassica rapa*, and which possess strong resemblances to the former, and have the power of fecundating species, varieties, and hybrids throughout almost the entire range of the genus,—even these cannot fecundate any variety of *Brassica oleracea*. All the varieties of the different species, however, are very liable to change or deterioration from the floral impregnation of other varieties growing in their vicinity, from the carriage of the impregnating pollen by bees, from the impoverishment of reproductive energy by bees and other insects, from the nature of soil, from difference of climate, from degrees of moisture in both air and land, from change in the period of sowing, and from some other circumstances whose precise nature and *modus operandi* have not yet been properly investigated. Judicious seedsmen will never grow crops of two varieties of brassica for seed in the near vicinity of one another, and will make a careful selection of circumstances for the separate growth of each variety.—*Horticultural Transactions*.—*Raddiff's Flanders*.—*Gardener's Magazine*.—*Farmer's Magazine*.—*Sproule's Agriculture*.—*Loudon's Encyclopædia of Plants*.—*Outlines of Flemish Husbandry*.

BRASSIN. The principal winter and fattening food of the stall-fed cattle of Flanders. It consists of the roots of turnips, carrots, and potatoes, and the meal of beans, rye, and buckwheat, either boiled together in a copper caldron, or first chopped together in a tub and then macerated with boiling water. This food, in a lukewarm state, and in the quantity of two pails full morning and evening to each cow, constitutes, with a little wheat-straw or barley-straw, the whole of the food of stall-fed cattle throughout the winter; and, in greater quantity, with the addition of more meal, and sometimes bruised linseed cake, it is the only food used for fattening cows and oxen. In the vicinity of the breweries of towns, grains are added to the other ingredients of the winter-feeding mixture; and they occasion a large increase in the cow's milk.

BRAWN. The pickled flesh of the boar. Boars of all breeds, ages, and sizes, are slaughtered for preparing it; but those which are largest in size and deepest in the shoulder, are esteemed the best. They are generally fed upon beans, and have a mixture of sulphur in their drink, and are killed about Christmas. Their carcasses are boiled, seasoned, freed from the bones, gammons, head, and feet, formed into collars, pickled, rolled up in cloth, and bound with tape. The precise method of preparation is, as much as possible, kept a secret by the manufacturers, and probably varies in different establishments, and has been altered and modified in the general progress of modern improvement. But the following method is mentioned in books of various kinds, published

during the last eighty years: "The bones being taken out of the flitches, the flesh is sprinkled with salt, and laid in a tray, that the blood may drain off; after which, it is salted a little, and rolled up as hard as possible. The length of the collar of brawn should be as much as one side of the bone will bear; so that, when rolled up, it may be nine or ten inches in diameter. The collar being thus rolled up, it is boiled in a copper or large kettle, till it is so tender that you may run a straw through it; when it is set by till thoroughly cold, and then put into the following pickle:—to every gallon of water add two handfuls of salt, and as much wheat-bran; boil them together, drain the liquor as clear as possible from the bran, and, when the liquor is quite cold, put the brawn into it." A good collar is about 30 lbs. in weight. Oxford has the highest reputation for the making of brawn; but Canterbury manufactures the greatest quantity. Drovers of boars come to the latter city about the middle of October, and are immediately placed aside to fatten, some singly, and others in groups of three and four.

BRAXY. A virulent inflammatory disease in sheep. It particularly attacks young sheep; has usually a very fierce character, and, in many districts, especially mountainous ones, occasions more loss than all the other diseases to which sheep are subject. It is the chief pest of the sheep farms of Scotland; and is there very commonly designated, as if *par excellence*, the sickness. Hogg, the well-known Ettrick Shepherd, distinguishes four varieties of it,—the bowel sickness, the sickness in the flesh and blood, the dry braxy, and the water braxy; and many of the old Scottish shepherds distinguish five varieties of it,—reed-sickness, small-guts sickness, blood sickness, flesh sickness, and liver sickness,—and, when the body of a sheep which has just died of it is opened, they affect to be able to determine, almost at a glance, which of the five varieties has occasioned the death. The variety which Hogg calls the water braxy seems to be the chief one known in the centre and south of England, and is there usually designated red-water. See the article **RED-WATER**.

All the varieties of braxy are inflammations, which spread with fearful rapidity and power, attack most of the contents of the abdomen, and speedily induce mortification. The abomasum, the intestines, the liver, the lungs, the diaphragm, the heart, the bladder, and nearly all the other parts of the interior system, are sometimes most visibly affected, or even converted into one putrescent and most stenchy mass of rapidly decomposing organism; some of the leading parts may frequently be observed to be more or less affected before the animal dies; and any of several of them may exhibit post mortem decomposition more than others, or even to the exclusion of the others, in consequence of modifying circumstances in the disease's progress, and even of the posture in

which the animal dies. If a sheep suffer from a mild form of the disease, or in circumstances which exert a check rather than a stimulus, upon inflammatory action, the abomasum alone will be found affected; if he suffer either standing, or in any other position which keeps the liver in close contact with the abomasum, the liver will be found putrid; if he die with his head downhill, the cavity of the heart and lungs will be full of serum, and the fleshy parts in the neighbourhood of these organs will be gorged with extravasated blood, while the intestines will be pretty free from inflammation; and if he die with his head up-hill, and lie in the same position for an hour or two before dissection, the heart and the lungs will be uninflamed, the cavity within the diaphragm free of serum, and all the forequarters comparatively sound, while the intestines will be surcharged with serum, and the fleshy parts of the flanks and head-quarters putrid with inflammation.

These are the diversities of both appearance and cause which have given rise to the popular belief that braxy is of various kinds; and they are such as might almost indicate to a perspicacious mind that both the original seat and the nosological character of the disease are in all cases the same. "The various appearances observable upon opening the dead animal," remarks Mr. Hogg of Atterstane, "have led to different definitions of the disorder,—have occasioned different parts of the bowels to be assigned as the place of its commencement, and sometimes different theories to be brought forward as to its cause. The rapid or tardy progress of the disorder, however,—the position in which the animal has been lying previous to or at its death,—the length of time between its dying and its being opened,—all these, in a carcass rapidly mortifying, with several other considerations which might be adduced, do readily, in different cases, and even in the same case, in a short time, and in no small degree, vary the appearance of the infected organs. The writer has dissected several hundreds that have died of sickness,—has opened them in all stages; and in the whole course of this his experience, there has not been above one case in a hundred where it was not evident that the reed was, or had been, the first and principal part affected." In a few cases, a carcass, on being promptly opened, discloses violent inflammation nowhere but in the abomasum; in very many, inflammation can be seen only in the abomasum, and the blood, with evident appearance that it began in the abomasum; and only in a very few cases of tremendous virulence and all-pervading putrefaction, when the very skin is decomposing, and serum is welling out upon the ground, or when the carcass is so dreadfully decomposed and so horribly offensive as to render attempts at dissection or examination impossible,—only in such extreme cases would a careful observer have any diffi-

culty in assigning the abomasum as the seat of the disease.

Braxy, then, is an inflammation of the abomasum, reed, or fourth and true stomach. The inflammation generally commences about the pylorus, or duct of communication with the small guts; and rapidly spreads over all the folds and inner coats of the abomasum. The transmission of digested food through the pylorus is soon stopped; and the heat and swelling of the abomasum and its contents speedily increase. A considerable quantity of serum is engendered about the bottom of the abomasum by the commencement of the inflammation; and this is rapidly augmented by the progress of the disorder throughout the interior of the stomach. The portion of food which was within the abomasum at the commencement of the disease, is, in some instances, found parched and exsiccated, while both the internal folds and the external surface of the organ containing it are a shapeless mass of serum and extravasated blood. As soon as the food ceases to pass through the pylorus, the upper portion of the intestines becomes inflated with gaseous matter of a strongly sulphurous smell; and the inflammatory action speedily passes into this portion of the intestines and into such adjacent organs as suffer pressure from the attitude in which the suffering animal is placed.

"Braxy," says Mr. Carmichael of Raploch, "is not contagious, nor does it early exhibit premonitory symptoms. The whole flock seems safe and well at night, and next morning twenty, perhaps, of the best (for the fattest are noticed to fail first) are found dead, within a small compass of ground, with no external marks of violence, and all lying in such a situation as to preclude the possibility of accident, but all at the same time presenting one and the same appearance. On examination, the body is found much swollen, and of a very deep red colour, particularly the side which is lying undermost, the whole intestines being highly inflamed, the membrane of fat enveloping the great gut extravasated with blood, and large globules of water interspersed; and, on turning out the intestines, a quantity of blood and serum is found floating within the body. The liver is healthy, and the gall-duct full, the heart distended, and the interior cavities filled with coagulated blood, even while the body is still warm. The lungs are very much distended, and the wind-pipe full of froth or frothy mucus, resembling soap-bubbles, which are largely suspended round the nostrils. The kidneys are much inflamed, the bladder is generally empty, the anus-duct full of very hard fæces, and the small or anterior portion of the intestines inflated with gas. The contents of the stomach, or first bag, are exceedingly dry and compressed, while that of the great gut is quite moist, as if fermenting, with a highly offensive smell." But the disease, though not contagious, frequently assumes an endemic char-

acter; for it often attacks the sheep of one farm, and passes by those of a neighbouring farm, and sometimes carries off so many as one-fourth of one large flock, while it scarcely touches another of the same breed, of similar age, and in similar circumstances.

The symptoms of the attack and of the earlier stages of braxy are very often unobserved; and even all symptoms intermediate between health and death are sometimes unnoticed. Many sheep seem well at night and are found dead in the morning; and many more, on being attacked, withdraw from the flock, and conceal themselves among brushwood or in other shelter, and are not missed or discovered before they die. But the symptoms, when observed, are described as follows by the Ettrick Shepherd:—"The loss of cud is the first token. As the distemper advances, the agony which the animal is suffering becomes more and more visible. When it stands, it brings all its fore-feet into the compass of a foot; and sometimes it continues to rise and lie down alternately every two or three minutes. The eyes are heavy and dull, and deeply expressive of its distress. The ears hang down; and, when more narrowly inspected, the mouth and tongue are dry and parched, and the white of the eye inflamed. The belly is prodigiously swelled, even so much that it sometimes bursts." Sir George S. Mackenzie more summarily describes the braxied sheep as "restless, lying down and rising up frequently, at intervals standing with its head down and its back raised, and appearing to run with pain." When only one or two sheep of a flock are attacked in the course of a week, they not uncommonly are attacked in the morning, struggle on all day, and die in the course of the night; but when many are attacked, or when they seem to fall beneath braxy as an endemic pest, they very often pass through all the phases of the diseases in about ninety or a hundred minutes.

Any remedy for braxy, in the vast majority of instances, is obviously quite unavailable or even altogether absurd. Most braxied sheep, long before their diseased condition can possibly be observed, are far beyond all possibility of cure. Only very mild cases, which happen to be detected in the very earliest stages of the disease, can be medicinally treated; and even these afford but a forlorn hope of success. A large quantity of blood ought to be drawn from any part of the body, either by notches made across the under side of the tail, or by venesection of any of the principal veins, but especially of the jugular vein or of that under the eye. An ounce of Glauber's salts, or even a handful of common salt, dissolved in a quart of cold water, ought then to be poured down the animal's throat; and on the second day, a clyster of broth with a good deal of salt ought to be thrown up to clear the lower intestines, and as much nitre as will lie on a shilling should be dissolved in an English pint

of cold water, and given in three doses, morning, noon, and evening. On the third day, also, or even on the fourth, the clystering and the dosing with nitre should be renewed; and, if requisite, the bleeding may be repeated. But these remedies, which are the best that have been tried, will, in most cases, either totally fail, or at best but diminish the sheep's pain and slightly prolong its life; and, in the few instances in which they succeed, the restored animals will be so exhausted and feeble as to incur every hazard of dying from leanness and inanition in the course of the winter or of early spring.

The proper treatment for braxy is obviously not cure but prevention; and this can be judiciously attempted only through acquaintance with the causes of the disease. Let us know what occasions braxy, and then shall we understand how the disease may be averted. One cause is boisterous, changeable weather, or rapid and great transitions from frosty to fresh, and from fresh to frosty. Another cause is drinking cold water, or plunging into a stream or pond, or being suddenly drenched with rain, or being chilled by a shower of snow, while the body is overheated. A third cause is winter-feeding on hill pastures with a steep northern exposure, and considerably overrun with ferns and brushwood. A fourth cause is a sudden or considerable change of pasture, or from a feeding on one class of herbage or aliments to feeding on another and considerably different class. A fifth cause is the eating of very succulent grass which is loaded with hoar-frost; and so powerful is this cause, that a night of hoar-frost, particularly about the end of autumn and beginning of winter, is very frequently followed on the next day, or within three days, by very numerous and fatal cases of braxy. A sixth and most virulent cause is the eating of hard, unwholesome, or indigestible substances; and this cause operates partly in connexion with culpable neglect of the proper care of pastures, partly in connexion with injudiciousness in the kind or manner of transitions from pasture to pasture in the progress of the seasons: and chief of all in connexion with the want of stells, turnip-feeding, or other appliances to prevent or lessen the entire dependence of the flock upon the herbage of the hills during the snows of winter. "When a deep snow lies long on the ground," remarks Mr. W. Hogg, "the hunger of the poor creature becomes excessive, and it catches at everything which rises above the frozen surface, such as rotten spratt, rotten and half-withered fern, rock-fog, &c.; and, in some situations, where it can get at the surface, of the earth, it bares away not only the sward, but a good deal of clay and sand. Such unnatural and indigestible substances mixing and going into the stomach with the food, meet with no obstruction, nor probably give the animal any uneasiness, till they reach the last department of the stomach. There these crudities inflame

the tender coats of the reed, the animal sickens rapidly beyond all conception, and sometimes in the compass of an hour dies." A seventh cause—the last which we shall name—consists in the improper treatment of lambs after weaning, and connects itself with the fact that hoggs or young sheep are the chief subjects of the disease, and that wether-hoggs are more liable to be attacked than ewe-hoggs. When weaned lambs are separated from the older sheep, and placed in flocks, or on pastures by themselves, they become impaired in their instincts, and are far less able than they would otherwise be to discern between wholesome and unwholesome herbage. Wether-hoggs suffer great enfeeblement of constitution from the effects of castration; and, if not nourished with the most tender food till they re-acquire constitutional energy, have not sufficient powers of digestion to resist the irritating action of many kinds of herbage which are easily digestible by strong and healthy sheep. Young sheep which are heated or exhausted by travelling or by any other fatigue, are impaired in stomach and have predisposition to disease until they reattain ease and composure.

Each of these causes suggests a correlative means of prevention. A shepherd ought to be well acquainted with the best prognostications of weather, and to provide, by removals of the flock, and other means, as fully as the condition of the farm will permit, against the refrigerations and excitements of great and sudden anticipated meteorological changes. All care ought to be used not to heat a flock by hard driving or otherwise during cold weather; and, when any heating has occurred, care should be exercised to prevent sudden cooling. Any pasture which has a steep northern exposure, or which, in other respects, is so situated as to make long retentions of cold and hoar-frost during the short days of winter, ought not to be depastured except during a steady continuance of open and comparatively genial weather. Transitions from pasture to pasture, especially at the close of autumn, ought to be either of a gentle or of a gradual kind, and never so violent as from soft, saccharine, and succulent herbage to a hard and bristling sward of bents. On every evening, which indicates hoar-frost, or early in the morning succeeding a night in which hoar-frost has formed, the hoggs ought to be removed from their lairs to higher and open ground till the hoar-frost disappears. Sedulous and skilful diligence ought to be practised to eradicate all ferns, heath, and brushwood from sheep-pastures, to sweeten the natural herbage by means of draining and other arts of georgy, and, occasionally, to alter and improve the quality of the aggregate growth of grasses by artificial sowings. The young of a flock, whenever circumstances and sound economy will permit, ought to be pastured with the old; all weaned lambs ought to be protected from overdriving and exhaustion; and all wether-hoggs ought to receive

special favour and considerable tenderness of treatment till they become confirmed in constitutional strength. Other preventatives of a general kind, exerting a protecting influence against all or several of the causes, are the giving of salt to young sheep, especially when suddenly shifted from fresh to dry food,—the erection of stells of sufficient capacity to suit the needs of a flock,—and especially the prompt and plentiful supply of succulent food,—turnips, whenever they can be obtained, and at least some oil-cake along with hay. In fact, the want of turnips upon upland store-farms, and the profusion of them for sheep-feeding upon champaign mixed farms, is a fact which of itself affords nine-tenths of a complete explanation of the phenomenon, that braxy is absolutely desolating among the hills, and is rarely witnessed upon the plains. The Ettrick Shepherd pronounces turnips “an infallible antidote against the progress of the malady;” and Mr. Carmichael says, “Turnips are so beneficial to hoggs, besides improving the soil, and requiring less extent of pasture-ground, that every store-master should attempt the raising of them; even one half-acre of good turnips to every twenty hoggs, with a few rations of hay, are excellent preventives of braxy.”—*Mackenzie on the Diseases of Sheep*.—*Hogg's Shepherd's Guide*.—*W. Hogg's Prize Essay on Braxy in the Transactions of the Highland Society*.—*Paper by Mr. Carmichael in Quarterly Journal of Agriculture*.—*A Lammermuir Farmer's Treatise on Sheep*.—*Spooner on Sheep*.—*Journal of the Royal Agricultural Society of England*.

BRAZIL-WOOD. A red dye-wood obtained from different species of *Cæsalpinia* growing in the Brazils in South America and in the West Indies. Several varieties are known in commerce. 1. The proper brazil-wood, said to be derived from *Cæsalpinia echinata*; and sometimes called Pernambuco or Fernambuca-wood from the province of Brazil, where it is collected. 2. The Brasileto, obtained from *C. Braziliensis* and *Crista*, which grows in Jamaica and other parts of the West Indies. The former is the most highly valued. 3. The Sappan or Sampfen wood, obtained from *C. Sappan*, possesses properties analogous to those of the brasileto; as does also 4. Nicaragua or peachwood. Brazil-wood is nearly inodorous, has a slightly sweetish taste, and a pale red colour, when newly cut, but which becomes deeper by exposure to air. It is hard, and heavier than water, to which latter it imparts its colouring matter. It contains, besides a colouring matter called *brasilin*, an essential oil, having the taste and odour of pepper, free acetic acid, acetates, and other salts. A decoction of brazil-wood produces a red precipitate with protochloride of tin, and a dark violet with sulphates of copper and iron. The principal use of Brazil-wood is in dyeing; a red lake is prepared from it. It is also an ingredient of red ink. Its colours are but of little permanency, fading by the influence of air

and light. Soap and alkali change them into a dark blue or purple.

BRAZING. The soldering together of edges of iron, copper, brass, &c., with an alloy consisting of brass and zinc, sometimes with a little tin or silver. The surfaces to be thus united must be filed perfectly bright, and not be soiled with the fingers or in any other way. The granular or nearly pulverulent alloy is usually wetted with a paste of ground borax and water, applied in this state, dried, and then exposed carefully to bright ignition at a clear forge fire. Some workmen enclose the part to be soldered in a clay lute, but others prefer leaving it uncovered, that they may see when the solder has flowed freely, and entered into all the seams.

BREAD. A food prepared from the meal or flour of the cerealia, by kneading it together with water into a dough, and exposing it to the action of heat, or baking it. There are two principal kinds of bread, *fermented* or *leavened*, and *unfermented* or *unleavened*. For the fermented or leavened bread, the dough is first made to undergo a kind of fermentation by the addition of leaven or dough, which is already in a fermenting state, or of yeast. The first is more uncertain and slow, and is apt to impart a sour taste. The *panary fermentation* seems to be an alcoholic fermentation of the same nature as that of saccharine matters, by which alcohol and carbonic acid are generated, which latter remains enclosed in small bubbles by the toughness of the gluten, and thereby raises the dough. The latter is then again kneaded over with some fresh flour, moulded or shaped into different forms, and after having been kept for a short time in a warm place to induce a new fermentation, by which they swell up to about double their original size, they are then *baked* or subjected to the action of heat in an oven, by which they still more enlarge by the dilatation of the enclosed carbonic acid, and become light and porous. Along with carbonic acid traces of alcohol are at the same time produced, but not in sufficient quantity to be worth collecting for economical purposes. By the *panary fermentation* not only a portion of the *amylum* passes into the saccharine state, and from thence into carbonic acid and alcohol, but a mutual action seems at the same time to take place between the rest of the *amylum* and the gluten, by which they lose their tenacious and glutinous character, and become more palatable and digestible. This change is still more increased by the subsequent baking, which puts a stop to all further fermentation or change by exposure to the elevated temperature and the evaporation of a great portion of the water. Good fermented bread can therefore only be made of such flour as contains a sufficient quantity of gluten, otherwise the bread becomes heavy, unpalatable, and indigestible. Wheaten flour affords, in this point, the best bread, and more or less of it is generally added to other kinds of flour for fermented bread.

Nothing in the art of baking is more essential than to have a due proportion of flour and water. That proportion, however, cannot be regulated by any certain rules; for it varies with the diversity of soil, climate, years, seasons, and grinding. There are some kinds of flour which imbibe precisely three-fourths of their weight of water; and others which imbibe only half their weight. That flour is always best which imbibes the greatest quantity of water; of course the method of discovering the quality of the flour is abundantly simple. Merely take a certain quantity of flour, and observe how much water it requires to make a good paste. Bread made of good flour, is about five-sixteenths heavier than the quantity of flour which it contains; of course it retains nearly one half of the water employed in forming the dough. These results, however, are by no means uniform; they depend not only on the quality of the flour, but on the manner of employing it, on the skilful regulation of the heat of the oven, and a variety of other circumstances. "By various mixtures of one kind of flour, less supplied with azotised matter, with another which is richer in this material, the equilibrium of the food which from meteorological causes prevailing in any particular country, may not have reached the proper standard, may be effectually restored. The wheat of England, for example, is inferior to that of the continent of Europe, and of America. It may, however, be improved by an admixture with foreign flour, or with oatmeal, barley, or beans; and in this state it will be found to form palatable bread. It is in the predominance of gluten over the other azotised materials that wheat owes its superior power of detaining the carbonic acid engendered by fermentation, and thus communicating to it the vesicular spongy structure so characteristic of good bread. By mixing one-third of Canada flour with two-thirds of maize a very good loaf is produced, and when equal parts of flour and oatmeal, or of barley, or of peasemeal, are employed, palatable bread is the result."—See 'Experimental Researches on the Food of Animals,' By R. D. Thomson, M. D. London: 1846.

The method of making household bread, practised by our bakers, is thus: To a peck of flour add a handful of salt, a pint of yeast, and three quarts of water; the whole, being kneaded in a bowl or trough, will rise in about an hour; it is then moulded into loaves, and put into the oven. For French bread, take half-a-bushel of fine flour, ten eggs, and a pound and a half of fresh butter, into which they put the same quantity of yeast, with a manchet, and tempering the whole mass with new milk pretty hot, leave it half an hour to rise, after which they make it into loaves or rolls, and wash it over with an egg beaten with milk: care is taken that the oven be not too hot.

"Mr. Henry, of Manchester," says the author last quoted, "in the end of last century, sug-

gested the idea of mixing dough with carbonate of soda and muriatic acid, so as to disengage carbonic acid in imitation of the usual effect of fermentation; but with this advantage, that the integrity of the flour was preserved, and that the elements of the common salt required as a seasoner of the bread were thus introduced, and the salt formed in the dough. The result of my experiments upon the bread produced by the action of hydrochloric acid upon carbonate of soda, has been, that in a sack of flour there was a difference in favour of the unfermented bread to the amount of 30 lbs. 13 oz., or in round numbers, a sack of flour would produce 107 loaves of unfermented bread, and only 100 loaves of fermented bread of the same weight. Hence it appears, that in the sack of flour by the common process of baking, 7 loaves, or $6\frac{1}{2}$ per cent., of the flour are driven into the air and lost. An important question now arises from the consideration of the result of this experiment: Does the loss arise entirely from the decomposition of sugar, or is any other element of the flour attacked? It appears from a mean of eight analyses of wheat flour from different parts of Europe by Vauquelin, that the quantity of sugar contained in flour amounts to 5.61 per cent. But it is obvious that, as the quantity lost by baking exceeded this amount by nearly one per cent., the loss cannot be accounted for by the removal merely of the ready-formed sugar of the flour. We must either ascribe this extra loss to the conversion of a portion of the gum of the flour into sugar and its decomposition by means of the ferment, which is highly probable, or we must attribute it to the action of the yeast upon another element of the flour; and if we admit that yeast is generated during the panary fermentation, then the conclusion would be inevitable, that another element of the flour, beside the sugar, or gum, has been affected. For Liebig has well illustrated the fact that when yeast is added to wort, ferment is formed from the gluten contained in it, at the same time that the sugar is decomposed into alcohol and carbonic acid. Now, in the panary fermentation, which is precisely similar to the fermentation of wort, we might naturally expect that the gluten of the flour would be attacked to reproduce yeast.

"A wholesome and palatable bread may be produced by the employment of ammoniacal alum and carbonate of ammonia, or soda, as a substitute for yeast. In this process the alum is destroyed by the heat: the bread is vesicular and white, and rises, according to the judgment of the baker, as well as fermented bread. It is obvious that none of the ingredients added can affect the integrity of the constituents of the flour; an occurrence which may possibly happen in the preparation of bread by the common process of fermentation, as has been shown, even to the azotised principles of the flour. The disadvantages of such a deterioration is sufficiently evi-

dent, if we view these principles as the source of nutrition in flour.

"A good method of making unfermented bread is to take of flour 4 pounds; sesquicarbonate of soda, (super-carbonate of the shops,) 320 grains; hydrochloric acid, (spirit of salt or muriatic acid of the shops,) $6\frac{1}{2}$ fluid drachms; common salt, 300 grains; water, 35 ounces by measure. The soda is first mixed with the flour very intimately. The salt is dissolved in the water, and added to the acid; the whole being then rapidly mixed as in common baking. The bread may either be baked in tins or formed like cottage loaves, and should be kept from one to two hours in the oven. Should the bread prove yellow, it is a proof that the soda has been in excess, and indicates the propriety of adding a small additional portion of acid; the acid varying somewhat in strength. The same process may be employed in raising the other mixture previously recommended."

We have hitherto considered bread as made of the flour of wheat; but there are many other farinaceous vegetables, from the seeds or roots of which salutary and pleasant bread can be prepared. Oaten bread is common not only throughout Scotland, but in Lancashire, and several of the northern counties of England. "When it is proposed," says Dr. Thomson in the work above referred to, "to make a loaf of oatmeal and flour, the common oatmeal should be sifted so as to obtain the finest portion of the meal, or it may be ground to the proper consistence. This should be mixed then with an equal weight of best flour, Canadian, for example, and fermented. I have not succeeded in making a good loaf with a smaller amount of flour than one half, although I have tried it in various proportions. If we were to attempt to raise oatmeal without an admixture with flour, in consequence of the absence of gluten, that principle which retains the carbonic acid of fermentation, we should obtain only a sad, heavy, doughy piece of moist flour. This form of bread, it appears to me, and to many who have examined it, would be a great improvement on the hard, dry oat-cakes, so much used in the more unfrequented parts of our country."

In baker's bread, which is always whiter than homemade bread, small quantities of alum are sometimes mixed into it, with the view of whitening or bleaching it. The smallest quantity for this purpose is from 3 to 4 ounces to a sack of flour, or 240 lbs. of flour, but it is increased in proportion to the inferiority of the flour. If so, it must be considered as an injurious addition, occasioning constipation, &c. Another article occasionally employed in bread-making, in order to make it lighter, and to neutralize any acid that may have been formed, is carbonate of ammonia. It being entirely dissipated by heat, its use may be considered perfectly harmless. Of injurious adulterations, small

quantities of sulphate of copper are said sometimes to have been added to bread in order to improve its colour. The most nefarious adulteration of bread consists in the addition of certain insipid and colourless earthy substances, with a view of increasing its weight, such as pipe-clay, porcelain-clay, chalk, plaster of paris, &c. All these adulterations are easily detected by incineration in a crucible, by which they are left behind, and may be examined. For ordinary purposes, the experiment may be performed by dissipating a portion of the bread over a coal-fire, on a fire-shovel, when the adulterations are left behind.

In times of scarcity, many attempts have been made to compensate for the want of corn, by the substitution of other vegetable substances, in the fabrication of bread. For this purpose, recourse has been had to the herb *ragwort*, the thick root of which, when taken out of the ground, is soft and viscous, but becomes hard in a short time, and may be preserved in that state for years, without changing, or requiring the slightest care. This root is easily ground, and yields a fine flour, which has an agreeable taste resembling that of a nut. From the acorn, too, a kind of meal is produced which makes excellent bread, provided that a little barleymeal be mingled with it, to counteract its astringent qualities. M. Parmentier extracted the farina or starch of the bryony, the iris, gladiolus, ranunculus, fumaria, arum, dracunculus, mandragora, colchicum, filipendula, and helleborus, and the roots of the *gramen caninum arvense*. It is only necessary to cleanse these roots, to scrape and pound them, and then to sock the pulp in a considerable quantity of water: a white sediment is deposited, which, when washed and dried, is a real starch. M. Parmentier converted these different starches into bread, by mingling them with an equal portion of potatoes reduced into pulp, and the ordinary dose of wheaten leaven: the bread had no bad taste, and its quality was excellent.

Rice bread.—Rice, though one of the roughest and driest of farinaceous vegetables, is converted by the Americans into a very pleasant bread. The process is as follows:—The grain is first washed by pouring water upon it, then stirring it, and changing the water until it be sufficiently cleansed. The water is then drawn off, and the rice, after being sufficiently drained, is put, while yet damp, into a mortar, and beaten to powder; it is then completely dried, and passed through a common hair-sieve. The flour, thus obtained, is generally kneaded with a small proportion of Indian corn-meal, and boiled into a thickish consistence; or sometimes it is mixed with boiled potatoes, and a small quantity of leaven and salt is added to the mass. When it has fermented sufficiently, the dough is put into pans, and placed in an oven. The bread made by this process is light and wholesome, pleasing to the eye and agreeable to the taste.—But rice flour will make excellent bread, without the addition of either potatoes, or any kind of meal. Let a sufficient quantity of the flour be put into a kneading trough; and at the same time let a due proportion of water be boiled in a caldron, into which throw a few handfuls of rice in grain, and boil it till it break. This forms a thick and viscous substance, which is poured upon the flour, and the

whole is kneaded with a mixture of salt and leaven: the dough is then covered with warm cloths, and left to rise. In the process of fermentation, this dough, firm at first, becomes liquid as soup, and seems quite incapable of being wrought by the hand. To obviate this inconvenience, the oven is heated while the dough is rising; and when it has attained a proper temperature, a tinned box is taken, furnished with a handle long enough to reach to the end of the oven: a little water is poured into this box, which is then filled with dough, and covered with cabbage leaves and a leaf of paper. The box is then committed to the oven, and suddenly reversed. The heat of the oven prevents the dough from spreading, and keeps it in the form which the box has given it.

Maize bread.—Maize bread may be made of good quality by a small admixture of flour. For this purpose, it should be reduced to a fine meal,—finer than is usual in America. It may then be mixed with one-third its weight of best flour, and fermented in the usual way. When thus prepared, the best maize bread is always dark coloured, and cannot be made much lighter than coarse wheat bread. The shade, however, is somewhat different from that of wheat, as it inclines more to a yellow tint. We may be quite certain, however, when we see what is called maize bread possessed of a white colour, that it contains much more than one-third its weight of wheat flour mixed with it. Even when one half its weight of wheat flour is added to it, the dark colour, characteristic of maize, is retained.

Potato bread.—Potatoes, mixed in various quantities with flour, make a wholesome, nutritive, and pleasant bread. Kliyogg—who has been styled the rustic Socrates—recommends, that potatoes well-boiled and carefully peeled, should be put into a kneading trough, covered with boiling water, and bruised till they be converted into a kind of soup of equal consistence throughout. A half, a third, or a fourth, of this soup, mixed with the flour of wheat, makes a bread of an excellent taste, salutary and nutritive. In Saxony, potatoes are prepared for bread in the following manner:—The largest are chosen, and, after being peeled, are grated very fine, and put into a milk pail. Cold water is then poured upon them, in which they are allowed to remain twenty-four hours. The water is then poured off, and fresh water is poured on them again: and this is repeated till the water which is drawn off be as pure as that taken from the spring. The potatoes are then put into a white linen cloth to be drained, after which they are spread upon a plate till dry. They are then reduced to a fine powder, and mixed with equal portions of wheaten flour, and with as much leaven as is usually employed for the same quantity of flour.

BREADCORN. Grain used as the staple of bread. The principal breadcorn of cold climates is barley and oats; of temperate climates, wheat and maize; and of hot countries, rice.

BREAD-FRUIT TREE,—botanically *Artocarpus*. A genus of ornamental, evergreen, fruit, and timber trees, of the nettle family. It abounds throughout the South Sea Islands, and in various parts of the East Indies; and is of great economical value, for various purposes, but particularly for its fruit and its timber; and it is cultivated also in the West Indies. Two species have been introduced to the hothouses of Great Britain; and six other species have been scientifically described. The true or cut-leaved species, *Artocarpus incisa*, was introduced from the South Sea Islands in 1793; and it comprises a variety called the nut-bearing, *A. i. nucifera*.

The Jaca tree or entire-leaved species, *Artocarpus integrifolia*, was introduced from the East Indies in 1778; and it includes a variety called the variable-leaved, *A. i. heterophylla*. Sir W. J. Hooker, however, thinks that all these are only varieties of one species, that both cut and entire leaves may frequently be found on the same plant, and that diversities in the flavour and quality of the fruit probably depend upon cultivation. The entire-leaved species or variety usually grows to the height of about 60 feet or one-sixth more than the cut-leaved kind; and it commonly has a trunk of from 8 to 12 feet in diameter. Some of its flowers are stamiferous, others pistiliferous; and both are produced on the same branchlet, the former chiefly on the sides, and the latter towards the extremity. The fruit is a muricated pericarp, and is very far from being uniform in shape. The fleshy part of the fruit is readily eaten by all the poor and middle classes of the natives, and forms a chief part of their food; and it is relished by some Europeans on account of its luscious sweetness, but, for a time, or till they become accustomed to it, is much disliked by others on account of its very strong and offensive smell. Aghastier, in his work on diet, says that it is apt to increase the secretion of bile, and that, when frequently eaten, it produces dyspepsia. The Cingalese, on whose island the tree grows most plentifully, and attains the greatest size and perfection, use the fruit, at particular times of the year, as a chief article of their food, instead of bread and rice; and they also use the unripe fruit, both when about the size of an ostrich's egg and when about the size of a cocoa nut, either in a pickled state, or cut into slices and boiled, or fried in palm oil. The fruit of another Indian species, *Artocarpus pubescens*, is also eaten much by the natives; and it has the singular property of causing a diarrhoea, which is cured by the root and bark of its own tree. When the fruit of *Artocarpus integrifolia* lies rotting under the tree, it emits an exceedingly disgusting odour, and affords support to hundreds of curculionidæ, staphylinidæ, and forficulæ. In Amboyna, the bats greedily devour the fruit; and, by passing its seeds unchanged, greatly extend the propagation of the tree. The sap or milk of this species is used for making a very viscid birdlime. The timber, when exposed for a considerable time to the air, acquires an appearance very similar to mahogany; and it is used both for constructing houses and making furniture.

BREAD-NUT,—botanically *Brosimum*. A genus of ornamental, evergreen, West Indian fruit-shrubs of the nettle tribe. Two species, *alicastrum* and *spurium*, were introduced to British hothouses from Jamaica, during the latter half of last century; and both of these usually grow to the height of about six feet. Another species, *microcarpum*, was introduced about eight years ago. The very remarkable vegetable pro-

duction, called by English travellers the cow-tree, by the inhabitants of the Caraccas Palo de Leche, and by Humboldt *Galactodendron utile*, has been thought by some naturalists to be a species of bread-nut. See the article COW-TREE.

BREAD-ROOT,—botanically *Psoralea esculenta*. A hardy, esculent, tuberous-rooted plant, of the clitoria subdivision of the butterfly-flowering portion of the leguminous tribe. It grows to the height of about a foot, and carries a blue flower in June and July. It is cultivated in North America as an esculent; and was introduced to Great Britain from Missouri in 1811. Pursh describes it in his *Flora Americanæ Septentrionalis*.

BREAK. Land ploughed the first time after it has lain two or more years in grass.

BREAK - FURROWING. The rib-ploughing of stubble-land with porous soil. Only the alternate furrow-slice is turned; and this is so deposited on the adjoining space that the stubbles of the very thin turned slice are applied to those of the unturned one. The stubbles, by this method, have sufficient circulation of air to decompose; and the porous soil is prevented from being too much pulverized by the action of frost. See the article **PLOUGHING**.

BREAKING. The reducing of an animal to a state of subjection; and, in particular, the accustoming of a young colt to the saddle or the yoke. The foal, immediately after being weaned, ought every day to be handled and partially dressed, and occasionally led about and made fast with the halter. After the second winter, the colt may, for days in succession, be accustomed, during an hour or so a-day, to a small bit of such a construction as will not hurt his mouth. If he is intended for ordinary farm-draught, he may be accustomed to piece after piece of the harness,—allowing him to be well used to one piece before subjecting him to another piece, and reserving the blind-winkers to the last. A few days after he has become accustomed to all the harness, he may be yoked into a team, with one horse before him, and another horse behind him, and all attached to a mere empty cart or waggon; he ought not to be further urged than by the strain of the other horses, and by an occasional patting and vocal encouragement; and after he begins to pull with the other horses, which he will do in the course of a few days, or of perhaps the very first day, the waggon may receive a gradually increasing load, to make him exert his muscles, and acquire the habit of draught. All severity and infliction of pain and use of forcible means ought, from first to last, to be most carefully avoided. Backing, which is by far the most difficult part of his work, must not be thought of till he has learned to draw; and it must be taught, first without any thing whatever being attached to him,—next, with a very light cart,—next, with a light load or heavy cart,—next, with a heavy load,—and, all through,

with studious care not to hurt his mouth with the bit. Blinding him while teaching him to back must not be thought of, unless he prove obstinate and restive; and not even then, unless all methods of coaxing and adroitness should fail. Prompt and uniform obedience will afterwards be best inculcated by firm, steady, kind, uniform treatment, and with a very infrequent, but smart and severe, use of the whip or goad. Refractoriness, restiveness, and all the other varieties of vicious habit in horses are, in all instances, more or less produced by cruel usage. A bland and soothing manner, combined with steadily commanding tone, will subdue any colt and train him to a cheerful performance of any work. Even when a colt is unusually resistive, and opposes with high and pertinacious spirit the earlier attempts to subjugate him, a combination of kindness and firmness may very speedily tame him, while a single act or two of harshness might drive him into prolonged rebellion, and perhaps permanent viciousness. When a young farm-horse is wanted for the saddle as well as for the yoke, he ought to receive his first lesson when in the team, and ought to be first mounted by the person who has been accustomed to feed him. The breaking of horses for the carriage and the chase, is the work of regular practitioners or 'breakers,' and therefore does not demand from us any particular remark. Yet we may say that, while the method usually practised by breakers is unquestionably good, it might be materially improved by studying the natural action of the horse, and especially by discarding much of its harshness, and infusing into it a considerable addition of bland though firm kindness.

BREAST-PLOUGH. An implement for paring off the sward or turf, in thin slices, from the surface of any piece of grass land. It is also called a paring-spade, a denshare, and a slaughter-spade. It was originally constructed to work somewhat like a plough, and to be pushed forward by the breast of a man. It consisted of a cutting-iron, about eight or nine inches long, and having one of its sides turned up to cut the turf. The iron was fixed to a pole bending upwards, about five or six feet in length, forked at the upper end, and having a crutch or cross-handle mortised into the forks; and the workman placed his breast against the crutch, and pushed forward the implement so as to pare and cut the turf. The breast-plough now in use is so constructed as to be pushed forward by means of a board or of woollen pads attached by straps to the front of the thighs; and it has a curved shaft, and is provided with a cross hilt which the workman grasps so as to guide his operations. Workmen usually break the pared turf into pieces of nearly uniform size by mere wrenches of the implement; they sometimes follow one another, in an extensive piece of work, in the same sort of order as a body of mowers; they, in most cases, find the working of the breast-plough very hard labour;

and, when the land is beset with furze or root-weeds, they require to be men of the most athletic powers. See the article **PARING**.

BRECCIA. A conglomerate, composed of angular fragments of rocks imbedded in or cemented by siliceous, calcareous, or ferruginous matter, is termed breccia. In many instances the fragments and cement are so firmly united that the rock may be broken, cut, and polished as a whole. See **CONGLOMERATE**.

BRECK. A breach or gap in a hedge.

BREECHIN. The part of a draught horse's harness which, while attached to the saddle and hooked on the shafts, enables him to push back the cart, or other vehicle, to which he is harnessed.

BREED. A variety of any kind of live-stock, particularly of the horse, the ox, the sheep, and the swine. Each breed is distinguished from other breeds by some invariable characteristics.

BREEDER. A stock farmer, or an occupant of a mixed farm, who employs much time and capital in the breeding and rearing of live-stock, and who uses care either to improve faulty breeds, or to preserve good ones from degenerating. See next article.

BREEDING. The art of rapidly multiplying and of improving domestic animals. Some wealthy and patriotic landlords expend much wealth, great patriotism, and not a little labour and science in improving local breeds of live-stock, in introducing superior breeds from other districts and countries, and in indoctrinating the agricultural community with enlightened principles in the art of breeding; but such men are benefactors of their country rather than breeders, and must be viewed, rather as patronizing the art of breeding, than as taking part in any of its ordinary cares and toils. Professional farmers, who labour for profit, are the only true class of practical breeders; and, while agricultural improvers desire such breeds as promise to be most beneficial to a whole country, practical farmers desire such as will yield the largest amount of profit in the particular circumstances of their respective farms. A wise practical breeder regards his live stock as an important portion of his property, and conducts the treatment and the increase of it with a direct view to the obtaining of the largest possible remuneration. He considers the nature of his farm,—whether dairy, pastoral, arable, or mixed; its locality; the amount and quality of its pasturage; the character of its soil; the adaptations of its climate, exposures, and elevations; the degree and kind of its resources for the support of stock in winter and spring; the markets to which it has the most ready access; and the varieties and comparative value of pastoral produce for which these markets maintain a demand. He will decide whether sheep-walk, or the dairy, or grazing, or a combination of objects promises to be most suitable; and will select only such principle of breeding as

suberves the department which he adopts. "The best beast for him is that which suits his farm the best; and, with a view to this, he studies, or ought to study, the points and qualities of his own cattle, and those of his neighbours. The dairyman will regard the quantity of milk, the quality, the time that the cow continues in milk, its value for the production of butter and cheese, the character of the breed for quietness, or as being good nurses, the predisposition to red-water, garget, or dropping after calving, the natural tendency to turn everything to nutriment, the easiness with which she is fattened when given up as a milker, and the proportion of food requisite to keep her in full milk, or to fatten her when dry. The grazier will consider the kind of beast which his land will bear, the kind of meat most in demand in his neighbourhood, the early maturity, the quickness of fattening at any age, the quality of the meat, the parts on which the flesh and fat are principally laid, and, more than all, the hardihood and the adaptation of constitution to the climate and soil." (*Youatt*.) The sheep-farmer will act on analogous principles with reference to sheep,—making his selections in adaptation to the situation and character of his farm, and with a view to produce in wool or in carcass; the breeder of hogs will consider the adaptations of his resources to one breed rather than to another; and the mixed breeder will take account, not only of the fitness of his farm for supporting particular kinds and breeds of domestic animals, but of the best methods of so economizing it as to maintain the most productive balance between the different kinds, and the most powerful reciprocity upon the fertilizing of the soil for the produce of grain.

The art of breeding live-stock for profit is very laborious to both body and mind. The purchasing of proper stock in the best markets, the collecting of them from different districts into one farm, the managing of the offspring stock from birth to maturity, and the disposing of the surplus in the most remunerating markets, involve great bodily exertion; and the care of the large capital requisite for the enterprise, the doubt whether the outlay for two or three years may be equivalent to the risk, the uncertainty as to the purchased stock producing a progeny as good in character as themselves, the daily solicitude in rearing the progeny to maturity, the fear of disaster from the attacks of disease, and the apprehension of loss from the fall of prices, impose a large degree of labour and trouble on the mind. Any man who begins to be a breeder, therefore, ought to have great powers of both bodily and mental endurance; nor will he ever be likely to enjoy much success, unless he also possess a large judgment and an enterprising spirit. A breeder who cultivates any sort of stock which he can most easily procure, or who rears it with little trouble or with merely routine care, has no right to expect any considerable remuneration.

A thoroughly prosperous breeder selects his stock with much discrimination, readily expends labour and money to obtain at a distance a better animal than he can procure at hand, keenly observes the practices or notes the principles of other successful breeders, and omits no practical precaution, however minute, for securing excellence in the progeny, averting disease, and effecting a plump, early, and ample maturity.

The natural progress of the art of breeding is well illustrated, by Mr. James Dickson of Edinburgh, in a supposititious case, which we shall here transfer to our pages. "The securing of the greatest profit in breeding with the least labour, consists in procuring that breed which will attain the greatest weight and maturity in the shortest time, and on the least quantity of food. On observing the progress of different individuals of the same breed of cattle, every breeder may have noticed that some individuals fatten quicker than others under the same treatment; and were the cattle of different breeds, the difference in the progress of fatness would probably be the more striking. Results so obvious cannot fail to rouse the inquiries of the breeder. How is it that animals of different breeds, or individuals of the same breed, fatten faster than others? They all receive the same attention and care, food and comfort. On inspecting the subject more closely, the breeder discovers that those animals which improve fastest, are the most beautiful to appearance, and most handsomely formed. Out of regard for them, he has a desire to handle and fondle them, when he makes a new discovery—he finds that their skins feel agreeable to the touch, are loose, and easily laid hold of. Their bodies are soft and fat, and he can press his fingers into the flesh, which springs back again in an elastic manner. He can also ascertain the same properties in the parents of the respective cattle which have thus exhibited them; and when he has made this observation, he has made another discovery. He thereby learns, that cattle possessing certain good and useful properties, have the power of imparting them to their progeny. He becomes convinced that good properties are hereditary; and, by a parity of reasoning and observation, he concludes that bad properties are also hereditary. He therefore retains the breeding stock which possesses the good properties, and disposes of the rest which possess the bad, and fills up their place with animals possessing properties similar to the first. His mind having thus been awakened to the proper course to be pursued in breeding, he perseveres in the selection of the best animals, and, in the course of time, his experience and taste correct the defects which may exist in even the minuter properties of his animals. Some of these minute defects may not exhibit themselves for some time, even for years; but when they do appear, the animals having them are removed, and those only cherished which have preserved all the good properties to the latest period.

"Having thus procured that breed which attains the greatest weight and maturity in the shortest time, and on the least quantity of food, not absolutely but relatively to other breeds (for it is perhaps not in the power of man to fashion an absolutely perfect breed of cattle, which these qualifications would indicate), the breeder's next consideration is how to preserve the good properties which have been acquired in his cattle. This consideration will be early impressed upon him, for he knows that the possession of any good thing is but a fleeting acquisition; for he sees that others more than he cannot retain a good thing permanently, for everything becomes the more evanescent the purer it is. He finds this to be true in regard to cattle. The good properties gradually disappear, one after another. The more minute properties disappear first, as it were stealthily, before he is aware of their disappearance. He finds, to his amazement and embarrassment, that his cattle are undergoing an evident change for the worse. They are becoming smaller, they are more tender, more easily hurt by change of food and weather; they show symptoms of internal disease, and some even die in spite of his attempts to preserve them. He becomes alarmed, he ascribes the change perhaps to some temporary change in the atmosphere, to some epidemic, which will pass away with the season; and, at all events, he cannot ascribe the mismanagement on his part, as a cause of the disheartening change. He is not conscious of having deviated from the exact line of conduct which has hitherto led him to prosperity and fame. He finds himself in a dilemma. If he continues as he has latterly proceeded in his method of breeding, he fears that the value of the cattle, upon which he has bestowed so much care, and of whose beautiful appearance he is justly proud, will decline every year. It is no easy matter for a breeder to extricate himself out of such a difficulty. The many conjectures which he forms to account for the unfortunate change, the epidemic among the rest, have now lost his confidence, and he begins to distrust his later management, and attempts to discover an error of judgment or of practice. But although an error of judgment or of practice had produced the effects, its immediate connexion with them may not be very apparent; and, at all events, he is reluctant to acknowledge that it is easy to account for so great a change as has taken place in his stock. He cannot conceive that a pursuance of the same plan which has perfected his animals, can at any time be detrimental to them. He resolves, however, to proceed in future with circumspection. The first precaution which he uses is to change his breeding stock, in that line whose progeny have shown the greatest change. He purchases a bull from the best breeder in the county. This is at least a safe step. On comparison, his eyes are opened to the lamentable fact, that his present favourite bull which has

procured him his stock, is not so perfect as other people's, nor what he has before had; he is fat enough, but seems bound together, and is small. He resolves that he shall serve no more of his own cows, but he puts him to a cow which he has bought, in order to mark the results of the double change which he is about to effect by introducing a fresh bull and a fresh cow into his stock. The results prove better than his expectations. He tried the experiments in doubt, but he exults in the results, because he is in the way of regaining his lost stock. The fresh breed exhibits the size, strength, hardiness, all the good qualities of his best animals. He now sees the necessity of changing at intervals, the blood in breeding cattle, in order to maintain them in that high and palmy state which imparts the greatest pleasure and profit to the breeder. He is convinced that without a change of blood in its constitution, or, in other words, without crossing, no breed of cattle can maintain its health and usefulness.

"Convinced though he be of this position in regard to crossing in the same breed, still he naturally asks himself, Will any kind of crossing produce similarly favourable results? Were any bull or cow used, would their progeny be as perfect as that of the crosses which he has just used? No reasoning can satisfy any man in the matter; experiment alone must answer those questions. But having already made experiments and succeeded, he may try others. He buys a bull of any breed different from his own. He puts him to one of his best cows. The result proves almost a failure. The progeny is no doubt strong and hardy, but it is coarse, and by no means an improvement on his own breed. Such an experiment shows that he should not rely on a confessedly inferior bull. He then finds that the crossing of breeds must not be conducted in an indiscriminate manner, that a superior bull is necessary, and that a superior cow cannot secure him against disappointment when coupled with an inferior bull.

"He will try another experiment, the converse of the last. He now buys a cow of a different breed from his own, and puts his best bull to her. The result is much superior to the last experiment. The progeny is not so fine as his own pure breed, but it is superior to its mother. It proves a rapid grower, kind feeder, has a good figure and hardy constitution. He is encouraged to proceed a little farther—he puts a fine bull to a cow of this cross. He is still not disappointed; the progeny is still not so fine as his own pure breed, but it approaches nearer in similarity to it than the first cross; and proceeding in this manner for generations, he ultimately finds that the coarse breed merges into his own. As he is still in the field of experiment, he tries the effect of a bull of a different breed from his own with a cow which is a cross between a coarse cow and a fine bull of his own. Instead of the cross improving

as it did with the fine bull, it is decidedly worse than its sire. He receives no encouragement to proceed in this direction. These latter experiments prove to him, that, were it possible, from the course of events, that no superior cow could be obtained, a superior bull would in time raise a stock similar to himself from a cow of a different breed; and that this cross should either remain as it is, because it is certainly a good cross, or it will merge, by means of a superior bull, into his own pure breed; but that, by an inferior bull, the cross degenerates at once."

In the present state of improvement, however, no man requires to pass through the progress of breeding, from a low to a prime condition; nor even while modern improvement was advancing, did any one man pass through the whole of that progress. Mr. Dickson's supposititious breeder is an impersonation of several or even most of the enterprising men by whom a chief portion of the existing improvement in breeds has been achieved. Any one man has, in general, but a limited range of experience, and both learns from the operations of his neighbours, and takes advantage of the achievements of his predecessors. Yet though the alleged facts in Mr. Dickson's delineation are not imaginary—though, for example, the breed which he represents as having been brought to the highest degree of perfection is the short-horned, and its degeneracy is indicated by pursuing the breed too near akin—the principles embodied in his sketch, particularly those respecting the effects and the alleged necessity of crossing, are very far from being undisputed.

The general object of improved breeding is to diminish or remove the defects of live stock, and to acquire and perpetuate desirable properties; the general art is to make such a selection of both males and females as is most likely to promote the object; and the general principle is the governing law of the animal kingdom,—the very obvious yet much forgotten maxim,—that like produces like, or that every variety, as well as species of animal, propagates its own kind. The simple observation, that domestic animals produce a progeny exactly similar to themselves, formed the basis of all the proceedings of our first great modern improvers of British live stock. Bakewell, in particular, inferred from this observation, that, by bringing together a male and a female both possessed of one set of good properties, he should obtain these properties, perhaps in an increased degree, in their offspring,—and that by propagating from males and females of the same properties through a series of generations, he should eventually establish a breed possessing these properties as a permanent and distinguishing characteristic. When he carried this process into effect, and found it to be successful, with respect first to his long-horns, and next to other breeds of cattle, the term "blood" began to be used as a designation of it; and, in all subsequent periods, whenever a breed with

any valuable characteristic can be referred to a number of ancestors of admitted excellence, this term is currently and emphatically applied. The principle of the improving process—that every variety of domestic animal propagates its own peculiar properties—is the pervading law of all scientific and successful breeding, holds true with regard to both the male and the female, and extends, not only to constitution, shape, and organic peculiarities, but to nosological tendencies and habits, and to almost every property, no matter how minute, which affects an animal's economical adaptations and market value. The exceptions to this law—even in spite of the seemingly dull and unimaginative character of the cow, the ewe, and some other domestic animals—are only such as arise from the occasional ascendancy of the mental power over the organic operation, and, like the vastly more frequent exceptions in the human subject—more frequent, perhaps, in the very ratio of the superiority of the human mind to the brutish—must be wholly ascribed to the play of imagination. “One of the most intelligent breeders I ever met with in Scotland,” says Mr. Boswell, “told me a singular fact with regard to what I have now stated. One of his cows chanced to come in season while pasturing on a field, which was bounded by that of one of his neighbours, out of which an ox jumped, and went with the cow, until she was brought home to the bull. The ox was white, with black spots and horned. The cow's owner had not a horned beast in his possession, nor one with any white on it; nevertheless, the produce of the following spring was a black and white calf with horns.” A still more remarkable instance is familiar to most readers of sacred scripture, as having occurred in the pastoral history of Jacob. Yet, notwithstanding all such exceptions, the tendency of each variety of domestic animals to propagate its own peculiarities, down to even the minutest point, is so prevalent and powerful as to be strictly a law, and perfectly accounts, not only for all the successes, but also for all the failures and for most of the apparent anomalies, in the progress of breeding improvements. “Let it be supposed,” remarks Youatt, “that the cattle of a certain farmer have some excellent qualities about them; but there is a defect which considerably deteriorates from their value, and which he is anxious to remove. He remembers that ‘like produces like,’ and he looks about for a bull that possesses the excellence which he wishes to engraft on his own breed. He tries the experiment, and, to his astonishment it is a perfect failure—his stock, so far from improving, have deteriorated. The cause of this every-day occurrence was, that he did not fairly estimate the extent of the principle from which he expected so much. This new bull had the good point that was wanting in his old stock; but he too was deficient somewhere also; and, therefore, although his cattle had in some degree improved

by him in one way, that was more than counter-balanced by the inheritance of his defects. Here is the secret of every failure,—the grand principle of breeding. The new-comer, while he possesses that which was a desideratum in the old stock, should likewise possess every good quality that they had previously exhibited—then, and then alone, will there be improvement without alloy.”

Three of the good properties, or “points,” as they are technically called, which breeders desiderate in all the species of live stock, are rectangularity of shape, robustness of constitution, and tendency to rapid attainment of maturity.—Rectangularity of shape is not understood with literal exactness, and never supposes the total absence of curvature, or the absolute filling up of the angles, and is more remotely exemplified in some species than in others, and in some good varieties than in others; still, it constitutes an excellent abstract model, and distinctly indicates the development and novelties of form which are requisite for making increasing approximations to perfection. The rectangle of the side figure of each animal is a parallelogram, and excludes the head; and that of both the front figure and the head figure is not far from being a square. A full-grown ox of prime breed fills the rectangles better than any other form of cattle on a farm; and a fat ox fills them better than a lean one. A Leicester tup with full wool fills them better than a tup of the same breed newly clipped. The gelding fills them better than any other form of the horse. But the hind view of the horse, unlike that of the ox, is always broader than the front view; and the hind view of the female is broader than the hind view of the male.—Robustness of constitution implies good appetite, healthy digestion, freedom from tendencies to disease, great power of endurance, sturdy health, steady growth to maturity, and facile ability of performing the offices which belong to the particular animal in the economy of the farm; and it is indicated by very numerous features in each animal, and by very diversified ones in the different species. The principal organs or parts of the body, particularly the lungs, the chest, the pelvis, the head, the neck, the muscles, and the bones, must be carefully considered in order to secure the possession and the due balance of the desirable properties. The comparative largeness of the lungs determines the comparative strength and health of the whole constitution,—it determines, in particular, the comparative power of taking up nourishment from food, and the comparative facility and rapidity of fattening; and it is therefore of very great importance, and is itself determined, or rather indicated, by the external form and size of the chest. The capacity of the chest depends more on its form than on the extent of its external circumference; for it may have an equal circumference in two animals, and yet enclose much larger lungs in the one

than in the other. The form of a truly capacious chest, containing large and powerful lungs, approaches the outline-figure of a cone, and has the apex of this figure situated between the shoulders, and the base of it situated toward the loins. A capacious pelvis, or lower cavity of the abdomen, is essential in a female, in order to avoid danger to both herself and her offspring in the production of her young; and it is indicated chiefly by the width of the hips and the breadth of the space between the thighs. The breadth of the loins is always proportionate to that of the chest and the pelvis. The comparative smallness of the head facilitates parturition, and generally indicates superiority of breed; and a head with small horns, or with no horns whatever, occasions considerably more economizing of food than a head with large horns. The length of the neck ought, in order to permit an easy collecting of food, to be proportionate to the animal's height. The muscles and the tendons, in order to permit an animal to travel or to work with ease and power, ought to be large. The bones, as compared to the muscles, ought to be small; for not bones but muscles are the seats of strength; and large bones generally indicate imperfection in the organs of nutrition. The several characteristic good properties of the several species, however, as well as the features which indicate them, will be fully discussed in the articles CATTLE, Cow, Ox, SHEEP, HORSE, and HOG.

A question of great niceness and difficulty, and one which has been the topic of much discussion and antagonism among agricultural writers, is, "Whether the breed of live stock be susceptible of the greatest improvement, from the qualities conspicuous in the male, or from those conspicuous in the female parent?" The Highland Society, about twenty years ago, proposed this question as a subject of prize essays; and afterwards adjudged four essays upon it to be worthy of premiums, and published them in their Transactions. Mr. Boswell of Balmuto, the author of one of the essays, asserts that the male is most influential, supports his opinion by an appeal to facts, and concludes "that the male is the parent, from motives of sense and sound polity, which we can alone look to for the improvement of our breed of live stock." The Rev. Henry Berry, the author of another of the essays, teaches that improving power in breeds is attributable, not to sex, but to high blood, or to animals, whether male or female, which have been long and successfully selected and bred with a view to particular qualifications; yet concludes "that, with our present scanty stock of information on this difficult question, one only rational course can be adopted by breeders, viz., that of resorting to the best male, a simple and efficacious mode of improving such stocks as require improvement, and the only proceeding by which stock already good can be preserved in excellence." Mr. Christian of Mill of Forest, another of the essayists, as-

serts that the offspring bears the closest resemblance to the parent, whether male or female, which exerts the greater influence in the formation of the foetus, and concludes that no individual animals, either male or female, can be trusted to for improvement, and that the best breed and most perfect animals of both sexes ought, in every instance, to be selected. Mr. Dallas of Edinburgh, the fourth essayist, asserts that the male is the more powerful for external qualities, and the female the more powerful for internal qualities, and infers that the male ought to be selected for the improvement of colour, coat, or outward form, and the female for the improvement of lactiferousness, hardiness, temper, and freedom from tendency to any description of internal disease.

The opinions of Mr. Boswell and Mr. Berry, if mutually combined, or if made to modify each other, appear to contain the whole or very nearly the whole of the truth upon this question; and the opinions of Mr. Christian and Mr. Dallas are altogether, or very nearly altogether, fanciful,—the one in theory and the other in fact. The power of blood, or of regular systematic, untarnished breeding through a series of generations, appears to be so great as wholly to supersede mere sexual or constitutional power,—and though peculiarly mighty in the male, is also not a little distinguished in the female. A cow possessing excellencies by pure descent from a high ancestry holds them as essential elements of her constitution, and will transmit them in all their breadth and beauty to her progeny; while a bull, possessing by tarnished descent from a near ancestry or merely by a cross of breeds on the part of his immediate parents, holds them as only secondary properties of his constitution, and may propagate them in a very marred and mutilated condition. The mare of Arabia is the grand object of the Bedouin's attention, and is constantly and carefully maintained in a condition of eminent excellence; and she, in consequence, bears all away in propagation, and often transmits her peculiar properties in defiance of antagonist ones in her mate. Still the male, by nearly the unanimous verdict of both practical and scientific observers, has, *ceteris paribus*, far more influence than the female; so that, when simply equal to her in descent and in some minor modifying circumstances, he at once maintains his excellencies by a mightier energy, develops them with a superior force, and propagates them with both a fuller breadth and a higher certainty. He also possesses a higher money value than the female, and becomes connected with a vastly larger number of offspring; and for both these reasons, as well as for the sake of his greater constitutional influence, he demands the prime attention of every breeder.

A farmer who commences to breed either cattle or sheep, ought to make first a deliberate decision as to the precise excellencies which he

wishes his flock to possess, and next a very careful selection of a male who exhibits these excellencies in the fullest development, and in freedom from accompanying defects. If he breed, at one time, with the view of obtaining animals with one set of properties, and at another time with the view of obtaining animals with a different set of properties, he is almost certain to miss the attainment of both the sets of properties, or, at best, to obtain them in a very deteriorated condition. But if he decide on precise properties, and use only males which purely and prominently possess them, and steadily prosecute the establishment of them in all his stock, he is morally and even physically certain of becoming the owner of flocks which shall exhibit them in perfection. Yet the selected males ought not alone to possess the desired properties full and uncontaminated, but to be the descendants of a series of progenitors who also thus possess them; and if they are themselves sires, their offspring must likewise and most especially thus possess them; for, unless a counteracting power can be distinctly ascribed to the dams, the offspring already existing is, in all respects, a type of that which may afterwards be produced. When a breeder of cattle, as usually happens, has not a sufficiently numerous flock to need more than one bull, he ought to observe well what faults are most prevalent among his cows, and to use all circumspection that none of these faults exist in the male which he selects; for unless he use these precautions, he may not only perpetuate but seriously augment the defects which depreciate his stock. When a farmer breeds upon a large scale, and uses several males at once, he can, with nicer aim and more certain effect, conduct the work of improvement; and he ought probably to select his males with slightly different groupings of good properties, and to appropriate each male to a specific or classified number of females with studied design to correct or remove particular imperfections. Most breeders of sheep use more than one ram; and all who make even moderate endeavours to improve their flocks, assign to each ram those and only those ewes whose defects are most likely to be reduced by his characteristic excellencies.

Lord Spencer's rules for the selection of males, though in some degree a repetition of what we briefly stated on the subject of "points," are well worthy of being quoted. "The first things to be considered in the selection of a male animal are the indications by which it may be possible to form a judgment as to his constitution. In all animals a wide chest indicates strength of constitution; and there can be no doubt that this is the point of shape to which it is most material for any breeder to look in the selection either of a bull or a ram. In order to ascertain that the chest of these animals is wide, it is not sufficient to observe that they have wide bosoms; but the width which is perceived by looking at

them in the front should be continued along the brisket, which ought to show great fulness in the part which is just under the elbows; it is also necessary that they should be what is called thick through the heart. Another indication of a good constitution is, that a male animal should have a masculine appearance: with this view, a certain degree of coarseness is by no means objectionable, but this coarseness should not be such as would be likely to show itself in a castrated animal, because it thus might happen that the oxen or wethers produced from such a sire would be coarse also, which in them would be a fault. Another point to be attended to, not merely as an indication of a good constitution, but as a merit in itself, is, that an animal should exhibit great muscular power, or rather that his muscles should be large. This is an usual accompaniment of strength of constitution, but it also shows that there will be a good proportionate mixture of lean and fat in the meat produced from the animal, the muscles being that part which in meat is lean. A thick neck is, in both bulls and rams, a proof of the muscles being large, and there can hardly be a greater fault in the shape of a male animal of either sort, than his having a thin neck. I am inclined to say, that in the new Leicester breed of sheep, which is the breed to which I am accustomed, a ram's neck cannot be too thick. Other indications of muscle are more difficult to observe in sheep than in cattle. In a bull there ought to be a full muscle on each side of the back-bone, just behind the top of the shoulder-blades; he ought also to have the muscles on the outside of the thigh full, and extending down nearly to the hough. It will seldom happen that a bull having these indications will be found deficient in muscle. As I am writing for the use of farmers, it is quite unnecessary for me to attempt to give a description of what is considered a well-shaped bull or ram; it is also obviously impossible to express in words what is meant by good handling. It is sufficient to say, therefore, that no male animal is fit to be used at all as a sire whose handling is not good, and that the more perfect his shape is the better."

The system of breeding within near degrees of consanguinity, or, in farmers' language, of breeding in-and-in, so as to perpetuate a stock of sheep or cattle solely from its own bulls and rams, has been the topic of much discussion, and was long the subject of divided and unsettled opinion. The degrees of consanguinity vary according to the size and circumstances of different flocks; but may, in a general view, be regarded as strictly parallel to those which prohibit marriage among the human species. The celebrated improver, Bakewell, after bringing his Leicester sheep and his long-horn cattle to perfection, always bred from his own stock, and thoroughly succeeded in preserving it from every appearance of degeneracy. Mr. Mason of Chilton successfully pursued,

for a time, the same course; other distinguished breeders have also, with various degrees of success, and for periods of various length, pursued it; a considerable number of breeders of the present day, particularly in England, still practise it, and regard it as the best; and several naturalists have appealed, for the vindication of it, to facts in the economy of wild animals, and especially to the instance of the exceedingly prolonged consanguineous propagation of the flock of wild cattle at Chillingham Park. "Mr. Bakewell," says Mr. Culley, "has not had a cross from any other breed than his own for upwards of twenty years; his best stock has been bred by the nearest affinities; yet they have not decreased in size, neither are they less hardy, or more liable to disorders; but, on the contrary, have kept on a progressive state of improvement. But one of the most conclusive arguments that crossing with different stock is not necessary to secure size, hardiness, &c., is the breed of wild cattle in Chillingham Park, in the county of Northumberland. It is well known that these cattle have been confined in this park for several hundred years, without any intermixture, and are perhaps the purest breed of cattle of any in the kingdom; and though bred from the nearest affinities in every possible degree, yet we find them exceedingly hardy, healthy, and well formed, and their size, as well as colour, and many other particulars and peculiarities, the same as they were five hundred years ago." Mr. Napier quotes this passage, and appears to concur in it; and Mr. Hayward argues at much length, on a diversity of grounds, and in formal opposition to Sir John Sinclair, in support of the doctrine which it inculcates. Yet the true law of either improving or undeteriorating propagation, so far as we can deduce it from a vast mass of conflicting observations, is that consanguineousness of breeding, viewed apart from other controlling or modifying circumstances, acts indifferently in the wild state of animals, and has a deteriorating tendency in the exact ratio of domestication. Mr. Bakewell, by a choice selection of individuals, improved his breeds up to the highest possible pitch, which became identical with the utmost possible degree of domestication; and he afterwards preserved his flocks from degenerating, only by careful attention to the utmost attainable proprieties of pairing, and especially by a constant and costly provision of the fittest climate, the amplest shelter, and the richest food. But had he either permitted his improved breeds promiscuous intercourse, or allowed them to live under the ordinary conditions of common pasturage on a common farm, he would probably have witnessed a deterioration almost as rapid as the previous improvement. His breeds, too, were but newly formed,—they, under his own management, came for the first time into the possession of the characteristic properties which constituted them varieties of their species; and they, therefore, in all or any of their tendencies to degener-

acy, were no more parallel to the long established good breeds of the present day, than a hybrid plant of the first generation is parallel to a hybrid of the fourth or the sixth generation. But the wild cattle of Chillingham Park are almost contrasts rather than parallels; for they have no properties whatever of "a breed,"—no qualities of a mere variety,—no "points" whatever of the very numerous and diversified class which characterize the countless breeds of domestic animals, and distinguish them from the untamed brutes of the forest; and, of course, they could not degenerate,—they could not lose or deteriorate properties which they did not possess. The acquisition of such properties as constitute a changeable variety is inseparable from domestication; the production of many and diversified groups of them is what constitutes the numerousness of the varieties of any species of domestic animals; the segregating of a group of good ones, to the exclusion of the bad, is what constitutes the art of breeding; and hence, the very proportion to which high breeding is carried, becomes, at the same time, both the proportion of domestication, and the proportion of liability to deterioration from breeding in-and-in.

Consanguineous breeding operates with full advantage in forming a new breed, or in developing and establishing any attainable group of new properties which may be desirable; but it ought to be thoroughly abandoned the moment the new breed is fairly formed, and never practised for the perpetuation of a breed which is well established. It originated the good sheep and cattle breeds of Bakewell, and the excellent cattle breed of Colling; but it first degenerated and then utterly destroyed the new Leicester breed of cattle, and has, on multitudes of farms, impaired the constitution and deteriorated the value of the new Leicester sheep and the short-horned cattle. After a breed is formed, the continuance of it by breeding in-and-in may, indeed, produce one generation or two generations of animals of extraordinary tendency to fatness, of remarkable form, and sometimes saleable at enormous prices; but it will just as certainly occasion the subsequent generations to be far more than proportionally degenerated in precisely the same properties. The bone of the in-and-in bred animal becomes very small in size, condensed in texture, and fine in form; the skin becomes very thin and porous, and ceases to afford any effectual protection against catarrh, consumption, and some other diseases; the hair of the ox becomes thin, short, and smooth, and the wool of the sheep thin, short, and watery; the body becomes finely rounded at its salient points, and looks as if smoothly and delicately stuffed within the skin; the carcass becomes greatly reduced in size, and possesses so powerful a tendency to fatten that, in all ordinary circumstances, it looks as if in constant condition for the shambles; the extremities become fine and delicate, the head and the

feet small, the neck thin and drooping, the ears thin and broad, and the head of the sheep bluish, almost bare, and exceedingly subject to excoriation by the sun and to attacks from the fly. The entire animal decreases in healthiness and activity, acquires tendencies to disease, becomes lean, dwarfish, and of a sickly appetite, and eventually loses the very capacity of propagation. The celebrated breeder Prinsep used strenuous, and expensive efforts, but without effect, to prevent in-and-in bred cattle from diminishing in size. Sir John S. Sebright made many experiments by breeding in-and-in with dogs, pigeons, and farm-yard fowls, and found the breeds in every instance to degenerate; and a gentleman tried in-and-in breeding with pigs till he found the females either becoming totally barren, or producing an offspring so small and delicate as to die almost immediately after being born. Mr. Hayward, who strenuously pleads for in-and-in breeding, says respecting these instances, "It may be remarked that pigeons, dogs, and fowls, from their long domestication, are already as much removed from a state of nature as nature will admit of; and being bred and fed more to please the fancy than for any defined object, it frequently happens that the most desired qualities are the effect of disease or distortion; and therefore, on the principles laid down, it might be expected that weak, diseased, or defective males and females being selected and paired, would produce those that are still more so. In the case of the pigs also, an effect is mistaken for a cause; these failures evidently arose from original defect, and a peculiar selection in pairing having been carried to an extreme, and not solely on the principle of breeding in-and-in." We hold this to be a full though extorted confession from one of the sturdiest advocates of consanguineous breeding, that the system, as regards all domesticated animals, and especially those which have become divided into many varieties or breeds, is essentially and mightily mischievous. For since degeneracy actually follows, no practical man cares a rush whether this be ascribed to in-and-in breeding itself or to the mere accidents or accompaniments of in-and-in breeding; and absolutely all the properties which distinguish the domesticated from the wild animals of a species, may, on certain principles of abstract or scientific reasoning, be pronounced distortions from nature, or diseased malformations,—and, at all events, the most useful or the most agricultural of them possess the same tendency to deteriorate and disappear as those which address themselves chiefly to the fancy, or are most confessedly "the effect of disease or distortion." Every breeder, then, who possesses a good stock, and wishes to preserve it from degenerating, must, every second or third year, introduce to it a new bull and new rams, and banish from it the old. The new bull and the new rams ought, as nearly as possible, to be of the same variety or shade of breed as the

old, and from a pasturage and a climate strictly similar; they ought, in fact, to be quite the same in all respects as the old, with the simple difference of possessing no relationship, or at least a very distant one; yet when the stock is not of prime quality or is characterized by some observable defects, the new males ought, of course, to possess not only all the same excellencies as the flock, but also the additional ones which the flock wants. The practice of crossing might, at first sight, appear to be but the converse of that of breeding in-and-in, but it really involves additional elements, and will form a fit subject for separate discussion. See the article *Crossing*.

In order to prevent at once unsuitable pairing in properties, breeding at an improper age, and breeding at an unsuitable season of the year, the males of a breeding stock ought to be separately depastured from the females, and not permitted access to the latter except by rule and upon system; and, in order to prevent the transmission of such half-tender habits as might not be able to withstand the ordinary pasturing conditions of a farm, the males ought not to be kept under better shelter or in more luxuriant circumstances than the females. If a heifer be put to the bull before she attain two years of age, she will not have a sufficient supply of nourishment for both herself and the foetus, so that both will suffer damage in constitution; and if she be not put to the bull till after she has attained three years of age, she may be in too high condition, and will probably not become pregnant. A heifer is generally in fittest condition between the age of two years and that of two and a half years. A bull ought never to be used at an earlier age than two years, and may be all the better if not used till three; yet, when not used till the latter age, he is in risk of becoming so ungovernable and dangerous that he must be killed. "Many contend," says Sir John Sinclair, "that the offspring of a bull, if well bred, becomes generally better till he reaches seven or eight years, and indeed till his constitution is impaired by age. This doctrine, however, does not agree with the practice of Mr. Vandergoes in Holland; nor can the question be finally decided without a regular course of experiments."—The proper age of the ram is not regarded as, by any means, an affair of such nicety as that of the bull. But an important rule, in reference to every favourite ram, is to examine his progeny of the preceding year, to observe their good properties and their defects in comparison with those of their dams, and then to assign to him only such ewes as are likely to avoid the defects and to propagate all the good properties.—On all farms, but particularly in high and exposed situations, breeding ought to be attended to at such a season that the young may be produced when the supply of suitable food is most ample,—neither so early as to involve the young in the disasters of insufficient feeding, nor so late as to expose

them, in too tender a condition of their body, to the storms and rigours of winter.

A natural law is believed to exist, occasioning an excess of males or of females in a flock, according to modifying circumstances which are, in a great degree, under the control of the farmer. This law is supposed to be, that, when animals are in good condition, well fed, and restrained in breeding, or when, by any combination of circumstances, they are in the most favourable state for increase, they produce an excess of females; and when they are in a bad climate, or on stinted pasture, or have already had a numerous offspring, they produce an excess of males. But whatever be the precise nature of the law itself, some experiments which indicate and illustrate it are sufficiently obvious for many of the purposes of practical guidance. M. Charles Girou de Bugareingues proposed, in 1826, to the Agricultural Society of Séverac, so to deal with flocks of sheep that an excess of males or of females should be produced at option; he divided each of two flocks which were submitted to him into two equal parts, the one to produce an excess of males, and the other an excess of females; and he recommended that the divisions which were designed for the excess of females should be served by very young rams, and enjoy an abundance of pasture, and that the divisions designed for the excess of males should be served by vigorous rams of four or five years of age, and enjoy no more than a moderate pasturage. In the first experiment, the division for excess of females were served by one ram of fifteen months and another of two years of age, and the two-year old ewes of it produced 14 males and 26 females, the three-year old ewes produced 16 males and 29 females, the four-year old ewes produced 5 males and 21 females, and the ewes of five years and upwards produced 18 males and 8 females,—thus showing a complete triumph of the principle in all the ewes below five years of age, to the total amount of 76 females against 35 males, but at the same time showing a failure or rather misapplication of the principle in the case of the older ewes, in the proportion of 18 males to 8 females; and the division for excess of males were served by two strong rams of respectively four and five years of age, and the two-year old ewes of it produced 7 males and 3 females, the three-year old ewes produced 15 males and 14 females, the four-year old ewes produced 33 males and 14 females, and the ewes of five years and upwards produced 25 males and 24 females,—thus showing a triumph of the principle in the aggregate of the division to the amount of 80 males against 55 females. The second experiment is reported by M. Girou as follows:—“During the summer of 1826, M. Courneau kept, upon a very dry pasture, belonging to the village of Bez, a flock of 106 ewes, of which 84 belonged to himself, and 22 to his shepherds. Towards the end of October, he divided his flock

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into two sections, of 42 heads each, the one composed of the strongest ewes, from four to five years old,—the other, of the weakest beasts under four or above five years old. The first was destined to produce a greater number of females than the second. After it was marked with pitch in my presence, it was taken to much better pasture behind Panonse, where it was delivered to four male lambs, about six months old, and of good promise. The second remained upon the pasture of Bez, and was served by two strong rams, more than three years old. The ewes belonging to the shepherds, which I shall consider as forming a third section, and which are in general stronger and better fed than those of the master, because their owners are not always particular in preventing them from trespassing on the cultivated lands, which are not enclosed, were mixed with those of the second flock. The result was that the first section gave 15 males and 25 females, the second 26 males and 14 females, and the third 10 males and 12 females.” M. Girou also made similar experiments with horses and cattle, and found them issuing in similar results.—*Napier's Treatise on Store-Farming*.—*Culley on Live Stock*.—*Hayward's Science of Agriculture*.—*Prize Essays of Messrs. Boswell, Berry, Christian, and Dallas in Transactions of Highland Society*.—*Papers by Mr. Dickson and others in Quarterly Journal of Agriculture*.—*Paper of Earl Spencer in Journal of Royal Agricultural Society of England*.—*Communications to the Board of Agriculture*.—*The Farmer's Journal*.—*The British Farmer's Magazine*.—*Sir John Sindclair's Code of Agriculture*.—*Buel's Farmer's Instructor*.—*Spooner on Sheep*.—*Youatt on the Horse*.—*Youatt on Cattle*.—*Rham's Dictionary of the Farm*.—*Stephen's Book of the Farm*.

BREWERY. See BREWING.

BREWERY-WASTE. The various refuse of the processes of brewing, available for the purposes of manure. Malt-dust, though often thrown away in small breweries, is extensively sold from large ones, and fully appreciated as a manure. See the article **MALT-DUST**. But much of other refuse of breweries, which might be easily and cheaply collected, and would exert a powerfully fertilizing influence upon the soil, is, in almost all cases, destroyed as sheer waste. A sediment separates and remains when the clear portion of the boiled infusion of malt is run off; another sediment, consisting of refuse or insoluble ferment, is deposited in the vessels in which the processes of fermentation are conducted; and both of these are rich in nitrogen, and act with the highest efficiency in decomposing the peat, sawdust, dry-leaves, and other strongly carbonized materials of compost heaps.

BREWING. The juices of fruits contain sugar, which is essential to the vinous fermentation; but this does not exist, in any important quantity, in seeds. Instead of it, however, we have starch, and this may combine with water,

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so as to form sugar. This combination is performed very perfectly by a vital process; that is to say, it takes place only in a living seed, and not in one which is frozen, burned, or otherwise killed. It is known by the name of *germination* or *growing*, and is of familiar occurrence, being what takes place in every seed that is successfully planted. The seeds of wheat, rye, barley, &c., consist principally of starch. If a grain of these is examined, we find near one end of it a small body, which is the rudiment of the future plant, and the microscope shows us that this consists of two parts—the *plumule*, which is destined to ascend through the earth to form the stalk, and the *radicle*, which is to be spread abroad below, and form the root. Whenever a grain of barley, oats, or certain other of the gramineous seeds, is exposed to water, it begins to swell and absorb the moisture; and, at the same time, if the temperature of the air is not too cold, the radicle thrusts itself out at the lower end; the plumule, on the other hand, pushes itself along beneath the husk of the grain to the other end, before it thrusts itself out. There are several curious considerations in regard to this process. The one which concerns us at present is this, that, as the plumule is passing along through the husk, the part of the seed along which it passes becomes changed into the substance known in chemistry by the name of *starch-sugar*; that is, when the plumule has passed along one-third of the length of the grain, that third is starch-sugar, while the remaining two-thirds are still starch; and so with the rest. The starch-sugar seems to be some combination of starch and water. The final cause of the change is undoubtedly the support of the growing plant, sugar being evidently necessary to the growth of plants, as it is always found in their sap, and sometimes, as in the sugar maple, in great quantities. The moment, however, the plumule begins to protrude beyond the end of the grain, the sugar diminishes, as it is consumed by the young stalk; and the substance of the seed is also consumed, though by no means to the same extent, by the growth of the root. To produce this change in seeds, and thereby to fit them for yielding a sweet fluid, when mixed with water, is the business of the maltster; and it is an operation of great delicacy, upon the successful performance of which the success of a manufactory of ale or beer in a great measure depends.

The first operation in malting is, to plunge the barley, or other grain to be malted, into a large cistern, containing water enough to cover the whole mass. The barley immediately separates into two parts; one is heavy, and remains at the bottom of the water, while the lighter portion, consisting of chaff, defective grains, &c., floats on the top. This latter is skimmed off as of no use. The heavier part, or sound barley, is suffered to remain till it has absorbed a portion of the water, sufficient for the purpose of enabling it to ger-

minate. This is *steeping*. It is the first process, and usually occupies about two days. When the grain is sufficiently steeped, the water is let off, and the grain thrown out of the cistern, and piled in a heap, or as it is technically called, a *couch*. After a few hours, the bottom and inner part of the heap begin to grow warm, and the radicle or root to make its appearance; and the germination thus commenced would go on rapidly but for the labour of the maltster, who, with a view of making all the grains grow alike, checks the growth of such as are in the middle of the heap by turning them to the outside, and *vice versa*. For this reason, malting cannot be performed, with any success, in summer, which would, at first sight, seem to be the fittest season. On the contrary, the best maltsters prefer the coldest weather; for, at this season, they can always keep the germination going on at the rate they wish, by heaping up the grain; whereas, in warm weather, it grows so rapidly that no effort can make the process equal and regular. Thus the grain is turned backwards and forwards for fourteen days, at the end of which period the *acrospire*, as it is called, or the plumula, having nearly reached the end of the grain, and the latter having acquired a sweet taste, the process of growth is suddenly and effectually stopped by spreading the whole upon a kiln, which is a floor of iron or tiles, perforated with small holes, and having a fire beneath it. There the life of the grain is destroyed, and it is thoroughly dried. The malt thus made is ground, or rather crushed, by passing it between a pair of iron rollers. It is then prepared for brewing.

The first step in brewing is called *mashing*. It consists in stirring up the malt with a quantity of hot water, which dissolves the starch sugar of the malt, and forms a sweet liquor called *wort*, similar to the must, or sweet juice of the grape, from which wine is made. The manufacture differs, however, in some essential particulars, at this stage of the process, from that of wine; for, if the wort were allowed, as the must is, to ferment without obstruction, it contains so much of the mucilage and starch of the grain, that it would run into the acetous, and from thence into the putrefactive fermentation, and would be *foxed*, as it is technically termed; that is, it would become ill-smelling vinegar instead of beer. To prevent this it is first boiled. This process renders it stronger by evaporating a portion of the water; and, further, it coagulates or curdles the mucilage, which subsides afterwards, and is not again dissolved, thus separating an injurious ingredient. While boiling, a portion of hops is added. One object of this is to give an aromatic, bitter taste to the liquor, which habit has rendered agreeable. The principal object of adding the hops, however, is, to check the tendency to the acetous fermentation, which is always far greater, in liquor so compound in its character as beer, than in the simpler liquors, as wine and

cider. It is further a common opinion, that hops add to the intoxicating qualities of the article; and this opinion is probably well founded.—After the worts are sufficiently boiled, they are poured out into large shallow cisterns or coolers, till they become cool and deposit much of the curdled mucilage. They are then allowed to run into a deep tub or vat to ferment. If left to themselves, however, the process would take place very imperfectly, and it is therefore assisted by the addition of yeast. The true nature of this substance, notwithstanding much attention and some laborious analyses, is not yet understood. It excites fermentation, however, which continues for a period of time longer or shorter, according to the fancy of the brewer, and is then checked by drawing off the liquor into barrels or hogsheads. In these the fermentation still goes on, but it is now called by brewers *cleansing*. With a view to take advantage of this process, the casks are placed with their bung-holes open, and inclined a little to one side. The scum as it rises, works out at the bung, and runs over the side, and thus the beer is cleansed from a quantity of mucilage, starch, and other unfermented matters. What does not run out at the bung subsides at the bottom, and constitutes the *lees*. After this cleansing is completed, the clear beer is racked off into barrels, and preserved for use. The scum and lees are collected, and the former constitutes the yeast for the next brewing.

Such is the general history of brewing, whether the product is to be beer, ale, porter, or wash, except that in the latter the cleansing is not necessary.—Even this racking, however, does not remove all the unfermented matter. Some starch and gluten still remain; of course, the liquor soon begins to ferment again in the barrels; but, as these are closely stopped, the carbonic acid gas, or fixed air, cannot escape, but becomes mingled with the beer. Every successive fermentation causes some lees, from which the beer may be racked off, and, by repeated racking, the fermentative matter may be completely removed, and such beers become clear, transparent, and somewhat like the German wines, as, for instance, that commonly called *hock*. But, the disposition to ferment being thus entirely destroyed, they are, like these wines, perfectly still, and acquire no disposition to froth by being bottled. Hence old sound beers may remain in bottles for years without *coming up*, as it is technically called. The object of the brewer is to produce an agreeable beverage, distinguished not so much for absolute strength, or quantity of alcohol, as for colour, flavour, transparency, liveliness, and power of keeping well. Some of these qualities are not compatible with the development of the greatest quantity of alcohol or ardent spirit, which is the main object of the whisky-distiller. To effect this purpose, he makes a kind of beer, which is called *wash*. This differs from brewers' beer in some important particulars. In the first

place, the grain is not all malted: in England, only a part of it is so; in the United States, generally, none at all. In the next place, it is ground a great deal finer than in brewing. If the brewer were to grind his grist as fine as the distiller, he would run great risk of *setting his mash*, as the phrase is; that is, he would make paste of his grain, and entangle the solution of sugar so effectually, that he could not get it out again. The distiller does not run the same risk, because he does not use such hot water as the brewer, and he can mash and stir his *goods* a great deal longer without injury, and even with benefit to his liquor. Again, he does not need to boil or add hops to his worts, for he does not care about precipitating the mucilage, or making his beer keep. In the next place, he adds a great deal of yeast, and ferments violently and rapidly, so as to decompose the sugar as quickly as possible, and is quite indifferent whether the worts even become somewhat sourish in the process, as, when sufficiently fermented, the alcohol is removed at once by distillation. If raw grain be ground, mixed with water at a certain heat, and allowed to stand, the change of the starch into starch sugar, or the combination of starch and water, takes place in the same way as in malting. It takes some time, however, and hence the distillers' mashes stand longer than the brewers'. It would seem, therefore, from this, that the malting of grain is not necessary for the making of beer; and, accordingly, this method of proceeding has been recommended by an eminent chemist, one who has paid much attention to this subject, and there can be no doubt that a certain description of small beer may be so made. But the process is not applicable to the finer and more valuable kinds of malt liquors, for reasons which it would require too many details to explain perfectly.

Besides the kinds of beer and wash already mentioned, there are others in common use made by mixing honey, molasses, or sugar with water, and fermenting with yeast, or some other leaven. Beers made in this way are commonly mingled with some vegetable substance, as ginger, spruce, sarsaparilla, &c., to give them a particular flavour, and are familiar to all by the names of *ginger beer*, *spruce beer*, &c. Of the beers manufactured from grain, as an article of consumption in that state, there are a great many varieties. See article BEER.

BREXIA. A genus of very fine, ornamental, evergreen trees, with the habit of the beautiful shrub *Theophrasta*. It does not hold any properly defined place in the Jussieuan system, and has hitherto been treated as constituting an order of its own. Its leaves throw off rain, and its flowers have a white colour, and are produced in axillary bunches. Two species, *B. madagascariensis* and *B. spinosa*, were introduced to Great Britain from the Mauritius and Madagascar in 1812, and another, *B. chrysophylla*, from Mada-

gascar in 1820; and all these require hothouse culture, and usually grow to the height of about 30 feet. Five other species are known to botanists.

BRIAR (SWEET),—botanically *Rosa rubiginosa*. A hardy, deciduous shrub, of the rose genus. The common sweet-briar is a native of Great Britain and of Switzerland, and is well known in every part of England and of the lowlands of Scotland. It is particularly abundant, in its wild state, on the chalky banks of England. It usually grows to the height of about five feet; its branches have a reddish hue, and are everywhere closely armed with strong prickles; the leaves exhale, from reddish viscid glands on their under surface, a very rich and grateful odour; and the flowers have a pink or pale red colour, and appear in May and June. The odour from the leaves is at once the richest, the best known, and the most extensively diffused of our native perfumes; it lusciously scents the air to a comparatively great distance around the plants; and it has deservedly rendered the sweet-briar a favourite in the vicinity of promenades, and won for it a place in almost all shrubberies and gardens. Though the plant has a gaunt, straggling, and wild appearance to the eye, and suits ill to grow side by side with anything ornamental, yet it grows well in corners, backgrounds, and other concealed spots, and secretly diffuses clouds of odours over all the walks in its neighbourhood. Four varieties of it, all bearing pink flowers, have been recognised by systematic botany;—the small-flowered, *R. r. micrantha*, growing wild in British thickets, blooming from May till July, and usually attaining a height of about six feet; the umbellated, *R. r. umbellata*, a native of Germany, flowering in May and June, and usually attaining a height of four feet; the hedge variety, *R. r. sepium*, growing wild in British thickets, and usually attaining a height of about three feet; and the scentless variety, *R. r. inodora*, growing wild in British hedges, and usually attaining a height of about six feet. But numerous other varieties and subvarieties are known to gardeners, and have as defined a place as any other garden roses in horticultural catalogues. The chief of these are the double, the tree double, the dwarf semidouble, the white semidouble, the American single, the zabeth, the blush, the clementine, the maiden, the scarlet, the mannings, the cluster, the mossy, the monstrous, the royal, and the petite hessoise. Some of these, particularly the double ones, possess the odoriferousness of the common kind, and at the same time are decidedly ornamental. "The flowers of the double blush sweet briar," remarks Marshall, "are of a pale red or blush colour, and every whit as double as the cabbage Provence rose; it cabbages in the same manner, and is very fragrant. No one need be told the value of a rose which has every perfection and charm, to the highest degree, both in the leaves and flowers, to recommend it." Among the newest or the most

admired subvarieties produced by hybridizing, the best is the madeleine or double margined hip.

A considerable subdivision of the rose genus takes the sweet-briar as its type, and is designated, from the botanical name of the sweet-briar, *Rubiginosæ*. Twenty species of this subdivision are now growing in Great Britain; but only one of these, *Rosa borrieri*, is a native, and this grows wild in our hedges, and has a similar height, habit, and florification to the common sweet-briar.—The eglantine, *Rosa eglanteria*, has been very generally, though incorrectly, identified with the sweet-briar. It forms quite a distinct species, belongs to the pimpinella-leaved division of the rose-genus, produces yellowish-coloured flowers, and has usually a height of about four feet. A well-defined variety of it is called *R. e. luteola*; but this variety has sometimes been named *hispida*, and the normal plant has been sometimes named *R. lutea unicolor*. Milton very improperly applies the name eglantine to the honeysuckle.

BRICK. An artificial or manufactured kind of stone, most extensively used in building operations. The brick offers some advantage over stone, arising chiefly from the expedition and ease with which the work may be conducted. Stone cannot always be procured, owing to local circumstances, but there are few positions in which brick-earth cannot be obtained within a few miles; and bricks are very portable, are square and ready formed, and if good, and used with good mortar, will produce a better and more durable wall than could be produced by small blocks of hard stone. The stability of a stone wall, with straight joints, depends more on the weight and magnitude of the stones than on the adhesion of the mortar; for as the harder stones are not absorbent, the mortar will not adhere to their surfaces and produce union; while, from bricks being of an opposite character, the brick and mortar, after a short time, become one, and their adhesion is so strong that it is difficult to separate them.

Bricks have, accordingly, been used by all nations from the earliest antiquity. The bricks of Babylon, many of which bear inscriptions, are known at the present day, and many of the admired relics of the ancients, still extant in ruins, exhibit the perfection to which the art of brick-making had arrived in these early days. Some of the structures of Egypt and Persia, the walls of Athens, the Pantheon and Temple of Peace, at Rome, and many other buildings, are constructed of brick. What is surprising, however, is that many of these bricks, which have stood the test of about 2,000 years, do not appear to have been burnt or submitted to the action of fire, to produce their hardness and durability, which can alone be attributed to the extreme dryness and heat of the climate in which they were exposed; for these bricks, on being soaked in water, crum-

ble to pieces, and disclose straws, reeds, and other vegetable matter, from the existence of which it is inferred they have never been submitted to any greater heat than that of the sun. At a later period all the bricks of the ancients were burnt, and it is these that chiefly remain at the present day.

A brick is nothing more than a mass of argillaceous earth or clay, properly tempered with water and softened, so that it can be pressed into a mould to give it form, when it is dried in the sun, and afterwards submitted to such a heat as shall bake or burn it into a hard substance. This method of forming bricks puts a limit to their magnitude; for, as the material of the brick is a bad conductor of heat, so, if they were made very large, the heat applied externally would never reach the inside so as to bake it properly, without vitrifying and destroying the outside; hence bricks must be confined to such magnitudes as will admit of their being well and equally burnt throughout. In England, the size of bricks is determined by law, and no man can make bricks larger or smaller than the prescribed dimensions. This law is, by many, considered a hardship, but it was established for a two-fold purpose, first, because all bricks were subject to an excise duty or tax of about a dollar a thousand, which tax could not be equalized, unless a size was fixed for the brick; and, secondly, it enables a person building, to know the exact quantity of work he can erect for a certain sum of money, and prevents brickmakers taking advantage by sending out small bricks, or making them so large that their insides may not be hard and well burnt, a circumstance that would produce unsound work, deficient in durability. The standard size in London is eight and three-quarter inches long, four and three-eighths wide, and three and three-quarter inches thick; the intention of these dimensions being, that each brick laid end to end, or every two bricks side to side, with the necessary quantity of mortar between them, shall make exactly nine inches of work; or that four bricks laid one on another, shall make a foot perpendicular, or twelve courses to the yard. Good brick, having the specific gravity of 2.168, requires 1,200 pounds on a square inch to crush it.

BRICK-MAKING. Although clay has been named as the proper material for making bricks, yet every clay will not answer equally well. Pure clay is quite white, and in burning does not change its colour, as may be noticed in tobacco pipes, which are made from it. The brown colour of common clay is usually derived from oxide of iron, and this causes the brick to assume a red colour when burnt; but as red bricks are not approved or used for outside work in London—where more bricks are made and consumed than in any other part of the world—the brickmakers have contrived means of changing their colour in burning to a pale buff very much resembling

the colour of Bath-stone, and which gives buildings a much handsomer appearance, and closer resemblance to stone, than would be expected. The mode of colouring is kept as secret as possible among the manufacturers, but it is partly produced by mixing powdered chalk with the clay, and is, probably, greatly dependent upon the firing of the kiln and the fuel used, since many bricks that exhibit a beautiful and perfect buff hue on their outsides, are red and dark within, if broken.

A stiff, tenacious, plastic clay is unfit for making bricks, as they generally split and fall to pieces in burning. Brickmakers call such clay *strong earth*, and they prefer what they term a *mild earth*; that is, one of less tenacity, and having more the character of loam. When the loamy soil is not found naturally, it is imitated by adding sand in considerable quantity to earth that is too strong. The London brickmakers, in addition to sand, constantly add a considerable quantity of *breeze* to their clay, and they assert that it is this material that gives the peculiar character of colour, hardness, and durability to London bricks. This is somewhat corroborated by the country bricks, made without breeze, being red and of a very different character. To explain the term *breeze*, which seems to perform so important a part, it becomes necessary to say that throughout the immense metropolis London, no fuel is used in any of the houses but bituminous or blazing coal. Every house has what is called a *dust-hole*, in some external part of the premises, into which the ashes and refuse of these fires are put, and the same place is also a depository for any other offal of the house, which must not be thrown into the streets. The parish-authorities contract with persons having horses and carts to clear these dust-holes about once a week or oftener, without any expense or trouble to the housekeeper, and the stuff collected is all carried to certain fixed depositories on the outskirts of the town. Here hundreds of men, women, and children, are daily employed in as sorting and looking over the mountains of discarded treasure thus brought in, and now become the property of the contractor; apparently worthless in the eyes of the public, but not so in fact, for most of the men who have undertaken this business, in conjunction with that of scavenger or street cleaner, have in almost every instance amassed immense fortunes. The heaps of soil are carefully raked over, and every atom of them passed through several gradations of sifting, with sieves of various fineness. Rags, old iron, metal, bones, and such things as are usually thrown away, mixed with the refuse fuel, form the aggregate of the mass, and all these things are separated and placed in separate heaps. Here the paper-maker gets supplied with much common rag for packing-paper. The old iron is returned to the forge to be manufactured into scrap iron. The hartshorn and ivory black

manufacturer gets supplied with bone, much new and unconsumed coal and cinders are obtained, and this furnishes the only fuel with which all the bricks of London are burnt, while the small and almost incombustible matter, consisting of very small cinders, and new coal, fire-dust, decayed animal matter, and whatever else may be mixed in the mass is *breeze*. This breeze is mixed with the clay, is in a great measure combustible when exposed to the high heat required to burn bricks, and it is said to assist the brick in getting red hot throughout its substance, and otherwise to improve it very materially.

A great deal of care and trouble is necessary in preparing the earth for making good bricks, in order to reduce it to one uniform texture, and to deprive it as much as possible of all stones that might destroy the form of the brick, by breaking in the fire, or becoming vitrified. The bricks of Philadelphia are in general so good, that we will describe the process used there for making them, and point out where it differs from that pursued near London. The clay in both places is invariably dug in the autumn, and during the winter before frost sets in. The ground is divided out into square allotments called spits, four feet wide and sixteen feet long, which surface when dug a foot deep, furnishes the right quantity of earth for 1,000 bricks, and of course each foot in depth is equivalent to the same quantity. This earth is shifted by barrows to an adjoining piece of ground previously levelled to receive it, and sunk a little under the general surface to prevent water running off. On this it is worked, if in a fit state to make bricks; if not, sand is added in sufficient quantity, according to the judgment of the workman, to make it sufficiently short or mild, and at this period the London brickmaker adds his breeze, which, answering the purpose of sand, it is added in less quantity. It is then cut, slashed, and worked with the spade, adding water to it to soften it; and the quantity of two spits being added together in one heap, sufficient earth to make 2,000 bricks is exposed to the frost in each heap, and the more severe the frost is, the better incorporation will take place. Nothing more can be done with it until spring, when the warm weather thaws the heaps, and if the frosting has been effectual no lumps will remain, but the whole will be converted into a uniformly soft and yielding mass. If too wet, the heaps are opened and spread to dry, or if too dry, more water is added, before the last working with the tool called tempering, in order to render the whole mass uniformly smooth; it is then pressed and patted down, and covered with boards, cloths, or bushes, to prevent the injurious effects of the sun and air, and is now ready for the moulder. The moulder works at a table or bench in the open air, covered by a shed roof only, to protect him from sun and rain, and the clay is brought to him in a barrow from the tempered heap, and is

placed by the boy who brings it on the left hand end of his table; another boy supplies him with dry silicious sand previously dug or provided, and placed on the right hand end of the table, and a third boy stands in front to remove the bricks as fast as they are formed. The mould is formed of mahogany or other hard wood, bound with iron for strength, and cased with iron plate on its top and bottom, or is sometimes lined with thin iron throughout; moulds have been formed wholly of iron, but they are too heavy for expeditious work, and cold to handle in early spring. The mould is four sides of a box without either top or bottom, as the moulding table forms the bottom, and must be very smooth, on which account, and to prevent wear, it may be covered with sheet-iron. The moulder first covers his table thinly with sand, and cutting off a sufficient quantity of the prepared clay with his two hands, finger-end to finger-end, to form about a brick and a quarter, he kneads it on the table, by pressing on it with the palms of the hands, first drawing it towards him and then pushing it from him, and patting the ends to bring it to a form similar to the mould into which it is to be introduced (the mould having been previously sanded), and presses it down with force, so as to fill up all the corners. The superfluous earth is now cut off by running a steel tool like a large thick knife, called a plane, along the top of the mould, when the top of the brick is sanded, and a thin board, called a turning board, as wide as the mould, and three inches longer than it is, is laid over it, and the whole being inverted, the mould may be raised carefully by the two hands, and the soft brick will be left on the turning-board, in which state it is taken away. Should any clay remain about the mould, it is now cleaned out and sanded, to prepare it for the next brick. It should here be observed, that the mould must be full half an inch or more longer, and a quarter inch wider and higher, than the brick intended to be produced, as all clay will sink thus much in drying, and sometimes more.

In order to receive the bricks when moulded, a high and open piece of ground is provided called the floor, and this is formed into what are called *hacks*. The hacks are perfectly level projections of earth about two feet wide, and rising six or eight inches above the surface of the floor, and are fifty yards or more in length, for receiving the bricks to be dried, and they should run in a north and south direction, in order that both sides of the pile may receive its due proportion of sunshine, and they must be about four feet apart to allow wheeling with a barrow between them. The boy that receives the bricks from the moulder, holds them by the ends of the turning-board and places them on a barrow constructed for the purpose, with a high raised stage of frame-work, that is level when the barrow is running, and holds twenty bricks. It must run upon planks to prevent concussion to the yet

tender brick. He carries them to a hack and lays them regularly upon it, leaving the turning boards under them until the row is nearly filled, and this allows time for the bricks to dry and become a little hard on the surface, which they will do in half an hour in fine weather. Another who is in attendance at the hacks, takes them up and moves them to the next adjoining hack, previously covered with sand raked smooth, and in doing so places them on their edges by inclining the turning-board with one hand, and applying the other to the brick, while he slides away the boards to be returned in the empty barrow to the moulder. The soft bricks are thus disposed in an angular manner like a worm-fence, but in no case more than two inches asunder in the widest part, and not touching anywhere. The row or hack being finished, the bricks are sanded on their tops, and if the hack is long, the bricks at the end first put down, will be dry enough to permit a second tier to be laid upon them, and so on until eight tiers or layers are so disposed, which is the greatest number that can be placed without danger of crushing or spoiling the shape of the lower bricks, and this number should not be attempted unless the hacks are long, and the weather fine and dry. The object of placing the bricks in this open manner, is to permit the air to blow through and dry them as effectually as possible, but they must not dry too rapidly, as that will cause them to crack. Should the sun be too powerful, the hack will require shelter, which is obtained by constructing a number of light frames, of a kind of basket work of twigs and straw interwoven. They are six feet long, as high as the hacks, and made as light as possible. These straw hurdles are so useful, no brickmaker should be without them; they afford shelter against both sun, rain, and frost, (which are the greatest enemies of the brickmaker in this stage of the business,) or they are set up in angular positions to catch and direct the wind into the hacks, if the bricks dry too slowly. Should violent rains come on which might destroy all the work, the top of the hacks must be thatched, by placing long wheat or rye straw transversely across their tops, keeping it from blowing away by planks laid lengthwise on them. The hacks are raised above the natural soil, for the purpose of keeping the lower tier of bricks out of the wet, should rain occur.

In about a week the bricks will be sufficiently dry for turning, which is done by moving them from the hack on which they were first dried, to the adjacent one left empty to receive them. They are now disposed as before upon their edges, but are put parallel to each other, about one inch apart, and the side that was before downwards is turned upwards. In the second tier or course, each brick is placed over the opening between the two below, and so of all courses that succeed until the eight tiers are again completed. In this manner they still expose considerable sur-

face to the air, and as the bricks have now become tolerably dry, and do not require sun, the last drying hacks are sometimes covered for their whole extent with a slight thatched roof, to protect them from rain; or if the kiln is not ready, they are sometimes moved into a building for safety. The hacks sometimes require turning three or four times before the bricks are sufficiently dry for the kiln, and the drying usually takes from three to five weeks, depending on the state of the weather.

Bricks are always made by piece-work near London, where a skilful moulder, having all things in good order around him, will mould and hack from five to seven thousand in a day of fourteen hours work, or about five hundred bricks per hour; but to accomplish this he will require six hands to wait on him, all of which are children. They supply him with the tempered clay and sand, and water to dip his tools into, remove the bricks as fast as they are moulded, and return the turning boards. Machinery is now coming into very general use in moulding brick; and it is superior to manual labour, not only from the labour saved, but from its yielding a denser and better quality of brick.

When small quantities of brick are required in a country where they cannot be obtained, or for particular jobs, the clay may be tempered and mixed by placing it on a hard bottom, and working it by a shovel or spade with water, and trampling it, instead of waiting for a frost to break it down. In this case more water must be added than is fit for tempering brick earth, but it can be got rid of afterwards by draining it away, or exposing the earth to dry; when the moulding and drying must be conducted as above described, but on a smaller scale. In the vicinity of London, where the demand for bricks is enormously great, the large brickmakers adopt a different method to that above described for tempering and preparing their clay, but there is no variation in the manner of moulding and drying upon the hacks. The clay is dug in autumn and frosted as usual; but instead of being piled in ridges or small heaps, the whole is wheeled into one immense pile, as frosting the interior is of less importance when machinery is used. At the breaking up of the frost the clay is carried in navigators' barrows to a mill called a *pug-mill*, where it is worked by horse-power, and incorporated with the necessary quantity of sand, chalk, or other material, and water, which is often pumped up and delivered into the mill, by the same power, in such quantity as will reduce the whole earth to so thin a state that it is just capable of running from an opening made in the bottom of the mill for its discharge. It is received upon a wire sieve or strainer, that stops all stones or foreign ingredients, if their size would prove prejudicial to the bricks about to be made. Two capacious ponds or reservoirs, about three or four feet deep, are formed for receiving

this diluted earth, and they are so placed in respect to the mill, that its produce can be discharged into either at pleasure, by means of wooden shoots or spouts. The pugged stuff is conducted into one reservoir until it is quite filled, when it is turned into the other; and while the second is filling, the earthy matter subsides in the first, leaving nothing but clear water at the surface, and this is carefully drawn off by withdrawing pegs, that are placed very close, one below the other, from holes in a thick plank let into the upper part of the reservoir. In this way the water is drained off and runs to waste, leaving a finely divided and most equable mud in the reservoir, which becomes of such consistence by draining, that it can be taken up by shovels, put into harrows, and be taken away. The discharge of the mill is then again turned into the first reservoir, which fills, while a similar draining and removal of the contents of the second is taking place. In this manner the clay is more minutely divided and broken up, or tempered, than could possibly be done by the former process of hand labour, and in its soft state, when first moved, is in excellent condition for receiving finely sifted breeze, or any thing else that may be necessary for improving the quality or colour of the brick. After this, all that is necessary for rendering the earth fit for the moulder, is a few days exposure to the air, to make it sufficiently dry for his use; and then the process proceeds exactly as before described, unless indeed a patent moulding machine should be employed, instead of a hand moulder, for forming the bricks, and then the compost is delivered to the machine, of which there are several varieties, said to produce more compact bricks than hand moulding, because greater pressure is exerted to compress the clay into the mould than can be exerted by a man working the whole day through.

The burning of the bricks is an operation of great nicety, because, if not burnt enough they will be soft and worthless, and, if overdone, they vitrify, lose their shape, and often run together so as to be inseparable and useless. Accordingly, various methods have been adopted for producing the due degree of firing, as it is called. In general, bricks are burnt in a kind of building constructed for the purpose, and called a *brick-kiln*; but in London, the burning constantly takes place in the open air, the bricks being made up into immense quadrangular piles, consisting of from two to five hundred thousand bricks in each. The built kiln is thought by many to produce the best bricks, or at all events, a larger proportion of good bricks out of any given quantity, and must certainly consume less fuel, but as they are never adopted in the immense brick manufactories of London, where no pains or expense for conducting the concerns in the best and most advantageous manner is spared, this is evidence that there must be some objections to

them, for if they possessed real advantages, there can be no doubt but they would be adopted. A brick-kiln, as usually constructed, is formed of bricks built into a square form like a house, with very thick side walls, and a wide door-way at each end, for taking in and carrying out the bricks; but these doors are built up with soft bricks laid in clay, while the kiln is burning, and a temporary roofing of any light material is generally placed over the kiln to protect the raw bricks from rain while setting, and so made that it may be removed after the kiln is fired. The English kilns are generally thirteen feet long, ten feet wide, and twelve feet high, which size contains and burns 20,000 bricks at once. Wood is the usual fuel used in these kilns, and they are frequently built with partitions, for containing the fuel and for supporting the bricks, in the form of arches, as will be presently described. A brick-kiln has no flue or chimney, as its chief purpose is to direct the heat of the fire through the body of bricks piled above it. To effect this they must be placed in a particular form with great care, and this operation is called setting the kiln, and is performed by one or two men who understand the business, and to whom the raw bricks are delivered in barrows. The form of the setting is pretty nearly the same in the country-kilns, or London clamps, except that in the latter the arches are much smaller, because wood is only used for kindling and not for burning. The bottom of the kiln is laid in regular rows, of two or three bricks wide, with an interval of two bricks between each, and these rows are so many walls extending lengthwise of the kiln, and running quite through it; they are built at least six or eight courses high. And this is permanent work, or work that remains in the kilns that have fire-places built in their floors, or has to be formed every time the kiln is set, when it has a flat bottom. The intervals between the walls are laid first with shavings, or light and dry brushwood, or any thing that will kindle easily, then with larger brushwood cut into short lengths, that it may pack in a compact manner; and, lastly, with logs of split hickory, or strong burning wood. This done, the overspanning or formation of the arches is commenced; for this purpose every course of bricks is made to extend an inch and a half beyond the course immediately below it, for five courses in height, taking care to *skintle* well behind, that is to back up, or fill up with bricks against the over-spanners. An equal number of courses, on the opposite side of the arch, is then set as before, and thus the arch is formed, which is called rounding, and is a nice and important operation, for if the arch fails or falls in, the fire may be extinguished, or many of the bricks above the arch may be broken. The intermediate spaces between the arches are now filled up, so as to bring the whole surface to a level, and then the setting of the kiln proceeds with regularity until

it obtains its full height. In setting the kiln, not only in its body, but in the arches also, the ends of the bricks touch each other, but narrow spaces must be left between the sides of every brick for the fire to play through, and this is done by placing the bricks on their edges, and following what is called the rule of three upon three, by brickmakers, reversing the direction of each course. The kiln being filled, the top-course is laid with flat bricks, so disposed, that one brick covers part of three others, which process is called *plating*.

The kiln being built, or finished, the firing succeeds, and this is the most delicate operation, and one that requires practice. The fuel is kindled under the arches, but requires close watching and attendance, for being in a large body, it would burn violently and produce so sudden a heat as would crack and spoil the lowest bricks. To check the burning, the arch-holes or mouths are closed with dry bricks, or even smeared with wet clay, in order to prevent the entrance of air, and rapid combustion that would ensue. The fire must be made to smother rather than burn, in order that by its gentle heat it may evaporate away the humidity that remains in the bricks, and produce drying rather than burning. The slow fire requires to be kept up about three days and three nights, by occasionally opening the vents, to supply air and additional fuel, and closing or partially closing them, until the fire gets up, as the workmen call it, that is to say, until it has found its way through all the chinks and openings between the bricks, and begins to heat those at the top of the kiln. To ascertain the progress of the fire, the top of the kiln must be watched, and as soon as the smoke changes colour from a light to a dark hue, the drying is complete, and the fire may be urged. The first, or white smoke, called *water-smoke*, is, in fact, little else but the steam of the water while evaporating, and when that is gone, the real smoke of the fuel succeeds, and now the vents may be opened to admit full draught, and a strong fire kept up for from forty-eight to sixty hours; but the heat must not be white or so strong as to melt or vitrify the bricks, and whenever it appears to be increasing too rapidly, the vents must be partially closed. By this time the kiln, if it contains thirty-five courses, will be found to have sunk about nine inches; but the stronger the clay the more it will shrink, and it is by this sinking that the workman knows when the kiln is sufficiently burnt. The experience of burning a few kilns will show how much the clay of that particular place yields to the firing. When it is thus ascertained that the kiln is done, the vent-holes, and all other chinks through which air can enter, are carefully stopped with bricks and clay, and in this state it remains until the bricks are cold enough to be taken down, when they are distributed for use.

From the nature of the above process it will

be evident that bricks of very different qualities will be found in the same kiln; for as the fire is all applied below, the lower bricks in its immediate vicinity will be burnt to great hardness, or, perhaps, vitrified; those in the middle will be well burnt; and those at the top, which are not only most distant from the fire, but exposed to the open air, will be merely baked, and not burnt at all; consequently, if they can be used, they must be reserved for inside work, that is not exposed to weather, or they will soon fail and crumble to pieces.

In the London method of open clamp burning, without any kiln, the piling and disposition of the bricks is the same as above described, except that the bottom arches are much smaller, as they are only intended to contain brushwood to produce the first kindling, and not for the future supply of fuel. No fuel is used except the breeze cinders and small coal before described, and this is distributed by means of a sieve, with wires about half an inch apart, over every course as it is laid near the bottom, and over every alternate course, or every third course higher up in the kiln. The first layers of this fuel are from an inch to an inch and a half in thickness; but they diminish as they ascend, because the action of the heat is to ascend, consequently there is not the same necessity for fuel in the upper, as in the lower part of the kiln. The brushwood in the bottom ignites the lower stratum of fuel, and from the nature of its distribution, the vertical as well as horizontal joints will be filled with it, and thus the fire gradually spreads itself upwards, and the whole clamp is nothing but a mass of bricks and burning fuel. The heat is therefore much more generally distributed throughout the whole mass, and in order to confine it, the entire outside of the clamp is thickly plastered with wet clay and sand, the bottom holes being opened or shut as occasion may require for regulating the draught of air. Notwithstanding the heat is much more equably distributed throughout this form of kiln, yet the outside bricks all around receive very little advantage from the fire, and are never burnt; but being on the outside they are easily removed, and are reserved for the outside casing of the next clamp that may be built; and being then turned with their unbaked sides inwards, some of them become available. On taking down the clamp, the bricks are assorted, in London, into three separate parcels or varieties, according to their perfection and goodness. Those that are burnt very hard but have not lost their figure or shape, are called *malms*, or malm-facings, or malm-paviors, and are used for facing good work; or for paving, for which their hardness makes them peculiarly suitable. The main body of the clamp produces well burnt and regularly formed bricks called *stocks*, with which the generality of houses are built; and such as are imperfectly burnt, and are soft, are called *place* bricks. These

last are used for inside partitions, backing walls that are to be plastered upon, and other work that is neither exposed to the eye nor the weather. These several varieties of brick have each a separate price, the best being worth almost twice as much as the worst. If the fire has not been carefully attended to, and has been permitted to get too violent, a few of the lower bricks will become distorted by partial fusion, and may fuse and adhere together, when they are called clinkers, and are useless for building purposes, but form an excellent road material. In the United States the names of bricks are different, but derived from the same source, being called hard burnt or arch bricks, body bricks, and soft or salmon bricks; though this last name is generally altered by workmen into sammy. The goodness of a brick is derived from its regular shape and appearance, its tenacity and hardness, its sound, and by its not absorbing water, or being affected by frost. The tenacity and hardness are judged of by striking one brick against another, or letting them fall upon stone pavement. Good bricks should have a sound approaching to that of a metal when so treated, and they ought to ring, and bear a very hard blow with the edge of the trowel, before they divide. If they readily break with a blow, or crumble to dust by a fall, such bricks are of the soft or sammy kind, and are unfit for introduction into a heavy wall, particularly on the outside of it, as they will be sure to be attacked by frost, and crumble to pieces. The absorbency of bricks is judged of by weighing them in the dry state, and then soaking them in water for an hour, and weighing them again. Those bricks that take up the greatest quantity of water, are the least fit for use, when they are to be exposed to its action. The average weight of a sound and dry London stock brick is 4 pounds 15 ounces avoirdupois.

Independent of the above, two other kinds of brick are made, called *cutters or rubbers*, and *fire-bricks*. Cutters or rubbers are very common in London. They are made of the best and most select materials, passed through a much finer sieve or strainer than the other bricks, and the whole manufacture is conducted with peculiar care, on which account they are expensive. They derive their name from their being so perfectly homogeneous, and free from stones or hard parts, that they may be cut with a saw, or chopped to any form, and then rubbed on a rubbing-stone until they obtain a perfectly flat surface. They are only used for ornamental purposes, such as constructing gauged or rubbed arches over doors or windows, niche heads, and the like. Fire-bricks are used for lining the insides of furnaces of all kinds, in which the heat may be so great as to fuse and vitrify bricks of ordinary materials. They are also used for that part of the setting of steam-engine boilers that is most exposed to the fire, and for lining the insides of fire-places intended for burning anthracite coal. Two varie-

ties of them are made, called Stourbridge and Windsor fire-bricks, both excellent, but of very different qualities, and they both derive their value from the peculiar local earth of which they are formed. The Stourbridge brick is always larger than other bricks, of a pale yellow or red colour, and when well burnt so hard that it will give fire with steel, and has no absorbent power. When broken, it may be seen that this brick consists chiefly of the same brick previously burnt, and reduced to coarse powder, and then made over again with an additional quantity of the same fire-clay. The Windsor brick, on the contrary, is made below the usual size, and is so soft and tender, that it can scarcely be handled without breaking, and when broken its whole substance is discovered to be nothing but sand, cemented and held together by a very minute quantity of argillaceous earth. This brick is of a deep, but bright red colour throughout, and is so soft that it may be cut to any required form by a common saw or knife, notwithstanding which, it withstands a higher heat than the former kind, and becomes very hard and durable after it has been exposed to such heat. On this account it is constantly used for forming the arch over wind or reverberating furnaces for melting iron. A similar brick is made at Cheam in Surrey, and as they are all stamped with PP. they are known under the name of PP. or Non-such bricks. The hard brick should be used in all furnaces subject to blows or concussions, as when large logs of wood are thrown in, or the fire has to be raked with large iron pokers; but for domes, or places not likely to be disturbed, and where the heat is very great, the soft bricks will be found preferable. Large blocks, called *lumps*, are made of the Stourbridge material, and are very useful in the construction of many furnaces. Fire-bricks are often made wedge-formed for building arches, and in segments of circles, for building round furnaces or flues.

Common brick earth is frequently formed into what are called *drain bricks*; they are made large enough to admit of having a semicircular cavity of about three inches diameter sunk into one of their sides, so that two of them inverted, one over the other, form a three inch tube, with a square outside.—*Millington*.

BRICK-WORK. In using bricks for building purposes, an even surface or foundation is first prepared, and should be truly level in each direction. This may be covered with mortar, and the bricks are then placed upon it flatwise, or with their broadest surfaces upwards and downwards, with mortar filled in between their vertical joints; but the general practice in beginning a wall is to lay the first or foundation course dry, or without mortar; that done, another layer of bricks is placed above the first, each layer being called a *course of brick-work*. Any course being finished, mortar is laid over a part of its upper surface to bed the bricks of the next course, and in this

manner the work proceeds upwards until finished. All bricks that are laid with their length in the direction of the length of the wall are called *stretchers*, and all those that take an opposite direction, or present their ends towards the faces of the wall are called *headers*, whether they are visible on the outer faces of the wall or are hidden within it. A *heading course* is one in which all the bricks that compose it are headers; and a *stretching course* has all its bricks laid as stretchers. All brick-walls ought to commence with a heading course, in order that the lower bricks may be so covered by the superposed wall that they cannot slip out of their places.

Brick-walls are generally described by the number of bricks that occur in their thickness, rather than by their dimensions in inches; thus we speak of a single brick-wall, a brick-and-half wall, two bricks, &c., and if the size of the bricks are determined, this at once gives the thickness of the wall, and then walls are spoken of as nine inch, fourteen inch, &c., walls. A four inch wall is one that is half a brick thick, or built with whole bricks all laid in the direction of their length. In paving with bricks, or bringing up courses to a proper level, the bricks are often laid with their thin sides upwards, and when so disposed this is called *brick-on-edge-work*. *Brick-on-end-work* is only used for paving floors, and in this the bricks are placed with their ends upwards. From the small dimensions of bricks a great part of the strength of brick-work depends on the joints being well and regularly broken, or so disposed that no two vertical joints shall occur in the same line over each other in two contiguous courses; or in other words, that good bond should be preserved; and yet to make the work look handsome, all vertical joints in alternate courses must be correctly over each other, so that if a long plumb-line should be fixed in any vertical joint of a piece of work at its top or upper course, that line should also cover or pass over the vertical joints in every alternate course below it.

In order to produce this regularity of appearance in the joints, so necessary to the handsome appearance of brick-work, as well as to break the joints and cause the bricks to overlap each other for procuring strength, bricks are always laid in particular forms distinguished by the name of *bonds*. Of these two varieties are used in England, and are called *Old English bond* and *Flemish bond*. Old English bond consists of alternate courses of all headers and all stretchers alternating with each other, except when the wall contains an odd number of half bricks, and then a single row of stretchers becomes necessary in each heading course, and a row of headers in each stretching course to make out the thickness of the wall. Thus, for example, in building a brick-and-half wall, or a two brick and half wall, such thickness can only be obtained as above, or by cutting whole bricks into halves, which would

occupy more time, and produce great waste of material. The first course of a brick-and-half old English wall would therefore be laid headers and stretchers, and the next higher course in succession would show its stretchers on the opposite face of the wall. If the wall is $2\frac{1}{2}$ bricks thick, the stretching course can be laid in the middle of the wall, and then the succeeding course may be all stretchers. And when the wall is two bricks thick, it may consist entirely of alternate courses of headers and stretchers. Neither of these last two methods is proper for building walls, because the joints are not sufficiently broken; for, as each of these courses has to be covered with a course of stretchers, it will be evident that a straight joint, or one without bond, will run through the whole length and height of each of these walls, and that there is nothing to tie the two faces together, consequently such walls would be liable to split in two in their vertical longitudinal direction when loaded, or carried to a considerable height. To obviate this, every third or fourth header should be laid in the middle of the wall, when its deficient length must be made out by pieces of brick called *batts*, or bricks cut to shorter lengths, which will not at all alter the external appearance of the face of the wall, but will add materially to its strength. Pieces of brick less than half-a-brick in width are often necessary in the face of a wall to shift a joint, so as to produce good bond, and such short pieces are called *closers*, pronounced *clashures*. The advantage of this kind of bond is that it contains no hollows or interstices, but is perfectly solid, and is therefore peculiarly well suited to any work in which great strength, rather than beauty of appearance, is desirable. It is therefore constantly resorted to both in masonry and brick-work, for the piers and abutments of bridges, the side walls of canal locks, and all such purposes. Flemish bond consists of headers and stretchers alternately in every course, but so disposed that no vertical joints occur over each other in contiguous courses. This bond is generally adopted in house building, because it is thought to look handsomer, and takes fewer bricks, or at any rate permits the builder to use a great deal of the small batts and broken rubbish that constantly occur in building; for no wall, consisting of an odd number of half-bricks, can be built solid when this bond is adopted.

The following is a return of the duties paid upon bricks in the several excise collections in England, in 1839 and 1845:—

COLLECTIONS.	YEARS.					
	1839.			1845.		
	£	s.	d.	£	s.	d.
Barum, . . .	225	7	5	387	5	1
Bath, . . .	3,507	8	4 $\frac{1}{2}$	1,084	0	2 $\frac{1}{2}$
Bedford, . .	4,901	1	11	8,361	7	7 $\frac{1}{2}$
Bristol, . . .	2,587	16	11	4,520	9	4 $\frac{1}{2}$
Cambridge, .	6,934	11	6 $\frac{1}{2}$	8,675	8	6 $\frac{1}{2}$
Canterbury, .	4,715	16	2 $\frac{1}{2}$	7,428	6	10 $\frac{1}{2}$
Chester, . . .	10,082	19	5 $\frac{1}{2}$	33,864	17	3

Cornwall, . . .	58	5	7½	200	3	1½
Coventry, . . .	12,821	14	4	8,949	8	4½
Cumberland, . . .	1,350	3	2½	2,216	19	9
Derby, . . .	7,056	11	10½	6,823	17	3½
Dorset, . . .	1,745	15	1½	1,894	14	6
Durham, . . .	5,239	17	7½	5,595	3	0½
Essex, . . .	11,036	10	7½	10,399	2	10½
Exeter, . . .	1,952	0	7½	1,741	11	7½
Gloucester, . . .	7,007	2	8	4,310	16	7
Grantham, . . .	8,918	11	6½	7,148	11	2½
Halifax, . . .	4,766	17	11	3,176	11	6½
Hants, . . .	3,429	7	7	6,535	0	8
Hereford, . . .	1,971	10	0½	1,808	12	5½
Hertford, . . .	9,113	7	4½	14,928	9	8½
Hull, . . .	7,041	7	10	12,359	3	1
Isle of Wight, . . .	5,665	7	6½	8,330	17	6
Lancaster, . . .	6,769	1	2½	9,615	6	8½
Leeds, . . .	10,853	1	6½	9,314	13	5½
Lichfield, . . .	13,360	8	8½	9,185	17	11½
Lincoln, . . .	8,398	12	10½	7,241	13	11½
Liverpool, . . .	14,699	6	7½	37,649	9	4½
Lynn, . . .	4,801	5	0½	8,071	4	3½
Manchester, . . .	34,793	5	8½	44,290	15	7½
Newcastle, . . .	7,450	16	5	6,664	2	6½
Northampton, . . .	5,483	10	3½	5,332	11	4½
Northwich, . . .	15,443	1	2½	12,244	3	0½
Norwich, . . .	5,292	16	0½	5,890	18	10
Oxford, . . .	2,770	15	2	2,670	4	0½
Plymouth, . . .	169	12	7	408	14	11½
Reading, . . .	4,314	5	2½	5,511	13	11½
Rochester, . . .	24,173	5	7	44,644	7	5
Salisbury, . . .	4,719	5	9½	4,793	4	7½
Salop, . . .	5,182	6	7½	3,900	16	5½
Sheffield, . . .	6,618	3	9½	5,056	7	5½
Stafford, . . .	11,002	2	5½	9,118	2	9
Stourbridge, . . .	24,665	16	3	18,574	18	7
Suffolk, . . .	6,744	18	11½	7,105	8	8½
Surrey, . . .	15,434	6	0½	58,680	16	0½
Sussex, . . .	14,691	9	11½	12,571	1	4
Uxbridge, . . .	21,651	3	6			
Wales, East, . . .	4,372	18	4½	5,874	8	7½
... Middle, . . .	946	18	10½	384	12	4½
... North, . . .	3,319	11	2½	3,133	7	1½
... West, . . .	226	3	6½	301	5	3
Wellington, . . .	6,420	7	4½	2,065	7	0
Whitby, . . .	6,186	17	3½	2,373	2	2½
Wigan, . . .	10,001	6	4	13,799	16	4½
Worcester, . . .	4,363	14	10½	3,643	12	3½
York, . . .	8,303	4	10	6,294	18	0½
COUNTRY, . . .	435,753	13	6½	527,148	1	1½
LONDON, . . .	23,911	11	6½	31,267	12	10
Total, . . .	459,665	5	1½	558,415	13	11½

BRIDLE. An implement of straps of leather and pieces of metal, for keeping a horse in subjection and controlling his motion. The several parts of a bridle are the bit or snaffle; the head-stall, or leather from the top of the head to the rings of the bit; the fillet, over the forehead and under the foretop; the throat-band, buckling from the head-band under the throat; the nose-bands, going through the loops at the back of the head-stall, and buckled under the cheeks; and the reins, attached to the rings of the bit, cast over the horse's head, and held in the rider's or driver's hand. See the article *BIT*.

BRIDLE, or MUZZLE. The terminating part of a plough, or that to which the draught is applied. The bridle of the East Lothian plough is attached to the point of the beam, and made subservient to the varieties of the draught, by

means of two bolts. The foremost bolt is permanent, and serves for the bridle to turn vertically upon; and the hindmost is moveable, and serves, by adjustment in different holes, to vary and determine the earthing of the plough.—The bridle of the Lanarkshire plough consists of a fastening or attachment for the draught, a draught-bolt, and a fork or sheers,—the last identical with the end of the beam; and the attachment for the draught yields a horizontal adjustment, while the sheers yield a vertical adjustment.—The bridles of other varieties of plough differ from one another and from these, with the same adaptation to peculiar structure as in these two ploughs. See the article *Plough*.

BRIDLE-HAND. The left hand of the horseman, being that which holds the bridle; while his right hand is the spear, sword, or whip hand.

BRINE. The steep liquor of salted flesh or salted fish. The name is frequently applied to the liquid as prepared for steeping; but it more properly belongs to the liquid which remains after the steeping process is completed, and even to that which continues with the salted flesh and salted fish after they are packed in casks or other vessels. All brine, in the latter sense, is powerful manure, and ought not to be treated as waste. It contains a certain degree of the same fertilizing elements as blood and oil, and is particularly rich in common salt. The brine of herrings, though indebted for very nearly all its fertilizing power to the common salt which it contains, has been extensively and effectively used for manure, and would be much more efficacious in inland districts than upon the coast. "A barrel of herrings," says Mr. Shier, "affords on an average three gallons of waste brine, containing in solution about 12 lbs. of salt, which gives for the total quantity cured, gutted and ungutted (at all the British fisheries, almost exclusively Scotch), in 1841, 3,574 tons of salt; and, including the undissolved salt found in the casks that have been emptied to fill up the rest, the salt amounts to 3,674 tons. Reckoning 2 cwt. a sufficient dressing for an acre of grass or grain crop, this quantity would dress 36,740 acres. The brine is generally sold at sixpence per barrel, which gives for the quantity mentioned £1,929. At many stations, the brine is not so carefully saved as it might be; and at the beginning of the season, when the fish are in the best condition, it is in greater demand than toward the close." See the article *FISH*.

BRINING. The application of brine to grass and grain crops, seeds, potatoes, or hay, in order to prevent disease or fermentation. A solution of common salt and water, in the proportion of a pound of salt to a gallon of water, aspersed upon a grain-crop with a plasterer's brush, nearly with the same kind of action as the broadcast hand-sowing of seed, is said to effect the instant destruction of mildew; and though it also damages some plants, it compensates that loss by the

ease and cheapness of its own application. A solution of salt and common water, or an addition of salt to sea-water, so powerful as to float a hen's egg, is one of several means which have been successfully tried for preventing smut in wheat. The seed intended to be sown is poured into this solution, and stirred in it; all which floats is skimmed off and rejected; and all which sinks is first drained upon a sieve, and afterwards sprinkled with siftings of newly slaked lime. The steeping of potatoes during four days in a strong solution of common salt destroys or greatly retards their vegetative power, and causes them to keep long in a condition fit for culinary use; yet they afterwards require to be washed in several successive ablutions with clean water in order to be freed from the salt. A better method of effecting the same object is to use ammoniacal water. See AMMONIA. A writer in an old agricultural work, the *Museum Rusticum*, says that, by a peculiar application of salt which is known in America as brining, he saved for the use of his cattle a crop of hay which had been so spoiled by rain as to be almost rotted in the field. "When my servants were making up the stack," says he, "I had it managed in the following manner: As soon as the bed of hay was laid about six inches thick, I had the whole sprinkled over with salt; then another bed of hay was laid, which was again sprinkled in the same manner; and this method was followed till all the hay was stacked. When the season came for cutting this hay, and giving it to my cattle, I found that, so far from refusing it, they eat it with surprising appetite, always preferring it to the sweetest hay that had not been in this manner sprinkled with salt." See the article SALT.

BRINJALL,—botanically *Solanum ovigerum ruber*. A variety of the common egg-plant. It produces dark-coloured, elongated, esculent fruit; and, for the sake of this fruit, it is extensively cultivated in the East Indies, especially in the vicinity of Bombay. It is also established as an esculent in the gardens of France, under the name of *aubergine*; and it has, for some time, been challenging the attention of the gardeners of Great Britain, and even sharing that attention jointly with the egg-plant. It is an annual plant, of sufficient tenderness to require greenhouse culture; yet is well-raised in a frame, upon a dung-bed. The seeds are sown in February; and from six to ten fruits are obtained from each plant. The fruits are generally used in India in curries and made dishes; but a better mode of using them, is first to divide them lengthwise, next to score them repeatedly across with a knife, next to dress them with butter, pepper, and salt, and finally to broil them on a gridiron.

BRIONY. See BRYONY.

BRISKET. A projection, partly muscular, but chiefly cellular and adipose, from the anterior and upper part of the chest of the ox. It sometimes extends from 12 to 20 inches in a pro-

jecting direction, and nearly as much in a perpendicular or descending direction. It varies in size in different breeds, and even in different individuals of any one breed; but it has always a comparatively great size in all the good breeds, whether old or improved. It does not, as many persons imagine, afford any indication of depth or capaciousness of chest; yet it is a very decided index of a tendency to fatten. The brisket of a well-formed ox is not only deep but prominent.

BRISTLES. The strong glossy hairs which grow on the back of the hog and the wild boar. They are extensively used in several of the useful arts, particularly in the manufacture of various kinds of brushes. The bristles of the wild boar are much stronger than those of the hog; and are imported in large quantities from Russia.

BRIZA,—popularly *Quaking-grass*. A genus of grasses, of the glyceria division. Both the botanical and the popular names allude to the nodding or trembling motion of the spikelets. The common or mediate species, *Briza media*, is also popularly called *Ladies-tresses*, and is an indigenous perennial of the pastures of Great Britain. Its stem usually grows to the height of about 18 inches; its florification is a panicle of short spikelets, tinged with purplish brown, and appearing in May and June; and its spikelets have an ovate form, stand on very slender foot-stalks, tremble in a gentle breeze, and give the plant an ornamental character. This grass is well-adapted to poor soils; it contains a larger portion of nutritive matter than most other grasses which grow upon poor soils; and it is readily eaten by horses, cows, and sheep. This grass, by experimental trial, yielded per acre, at the time of flowering, on a poor, unmanured, sandy soil, 10,890 lbs. of herbage and 453 lbs. of nutritive matter; on a moist, clayey, unmanured soil, 8,167 lbs. of herbage and 293 lbs. of nutritive matter; and on a rich black loam, 9,869 lbs. of herbage and 462 lbs. of nutritive matter.—The smaller species, *Briza minor*, is an annual plant, grows wild in the corn-fields of England, usually attains a height of about six inches, and flowers in July and August. The greatest species, *Briza maxima*, is also an annual; it was introduced from the south of Europe before the middle of the 17th century; it has usually a height of about 18 inches; and it flowers in June and July, and presents a decidedly ornamental appearance. The taller species, *Briza elatior*, is a biennial, has generally a height of about 18 inches, and was introduced from Greece in 1817. The jointed species, *Briza geniculata*, is an annual, has a height of about a foot, and was recently introduced from the Cape of Good Hope. Clusius' species, *Briza Clusii*, is a perennial, has about the same height as the preceding, and was recently introduced from the South of Europe. The green species, *Briza vir-*

ens, is an annual, has a height of about 18 inches, and was introduced in 1800 from Spain. All these species, but particularly *Briza maxima*, are grown in gardens as ornamental plants; and two other species, of a non-ornamental kind, the humble and the red, were recently introduced.

BROADCAST SOWING. The sowing of either fields or garden-plots by scattering or aspersion. This method of sowing is contrasted to the drill-method; it was, for a very long time, the only one practised; and, till quite a recent period, it was always performed by hand. The broadcast sowing of fields by hand requires such nice, peculiar, and yet simple dexterity, as almost to defy verbal description; but at the same time, is so well known in all the rural districts of the civilized countries of the world, as not to need to be described. The measured step, the regular manipulation, and the artificial cast of the sower can be learned only by observation and practice. An experienced and skilful sower regulates the prescribed quantity of seed to the acre with admirable precision, and asperses the seed over each portion of the ground with exactly equal distribution; but an inexperienced or a careless sower lifts the seed in unequal handfuls, gives more seed to one part of the field than to another, leaves naked streaks between the aspersions of the successive casts, makes an irregular play of fingers in each opening of the hand, or fails to make due allowance for the disturbing power of the wind upon the seed. Every step or throw of a bad sower is sometimes distinctly traceable at harvest in alternations of comparatively bare intervals and thickly crowded curves. Irregular broadcast sowing not only offends the eye and wastes the seed, but occasions the crop to be unequal and deficient, and causes a most mischievous distribution of the seeds of ryegrass and clover which may be sown with the grain. These seeds require to be scattered or sown by very small pinches; and when not equally distributed by a judicious twirl of the hand in throwing them out, they grow up in such a manner that a third or even upwards of a third of the field is totally unprovided with any other vegetation than weeds, and the "wales" or crowded curves, on which the bulk of the seed was thrown, are so crowded with plants as to be unable to produce them in a vigorous condition. Sowers in Scotland and Ireland carry the seed in a sheet slung over the right shoulder; and those of some districts in England carry it in a basket, hung round the neck, and held by the left arm thrust through the handle. Some very expert sowers sow with both hands, throwing it right and left, and doing double the work of single-hand sowers; but they can hardly be expected to sow as regularly with the left hand as with the right, and may be supposed to occasion more loss by inequality of work than gain by saving of time. The broadcast sowing of clover and grass-seeds, is considerably more difficult than

that of grain, and frequently requires to be performed by a different arrangement, the sower either making narrower casts or going twice over the field. Broadcast sowing in gardens is generally required on so very small a scale that only the most lumpish bungler performs it ill.

Broadcast sowing in the fields, where not superseded by drill sowing, is now, in some of the best agricultural districts of Britain, particularly in the lowlands of Scotland, performed by means of broadcast sowing-machines. The earliest of these machines in Scotland was first used in the year 1817; and they have since been materially improved in construction, so as to perform their work with at once regularity, efficiency, and economy. They deposit seeds with the same nicety as the drill sowing-machines, and occasion very considerable profit over the hand-sowing method by the saving of the seed, and especially by the equal growth and superior quality of the crop. The broadcast sowing-machine, which is modelled in the museum of the Highland Society, and which may be regarded as a fair specimen of the several varieties in use, is adapted to the sowing of all the white grains and the grasses. "It is drawn by one or two horses, and sows a breadth of 18 feet; but is capable of contraction to 15 feet, or less if required; and can be regulated to sow from two to five bushels per acre. It is mounted on three wheels, the front wheel being on a swivel-bar, and one or both of those behind serves to turn the distributing-machinery. The principle of the distribution consists in a line of small thin-toothed wheels revolving within the seed-chest, each wheel being immediately over a distributing orifice; and through these orifices the seeds are discharged by the revolution of the wheels, which are immersed in the grain. A perfect graduation of the orifices is obtained by means of a slider which has an equal number of perforations coinciding exactly with the orifices, when the full opening is required. But the sliders are capable of adjustment to any degree of contraction of the orifices by means of a screw; and again, by a lever, the orifices can be shut entirely and reopened to the same extent as before as often as may be required." A sowing-machine for grasses is this common broadcast machine, with the addition of apparatus, for the express purpose of sowing down with grass seeds. A roller follows immediately after the seed; and the roller is followed by a harrow. See the articles **SOWING** and **SOWING-MACHINES**.

BROCCOLI. A well known cultivated sub-variety of the cabbage species. The common cabbage, viewed as inclusive of all varieties and subvarieties, is botanically designated *Brassica oleracea*; the variety of it which has a clustered florification, somewhat in shape like miniature bunches of grapes, is designated *Brassica oleracea botrytis*; and the broccoli subvariety of this, as distinguished from the cauliflower subvariety,

and on account of a fancied though remote resemblance to asparagus, is designated *Brassica oleracea botrytis asparagoides*. But though uniformly regarded by gardeners, and pretty generally by even systematic botanists, as a distinct plant from cauliflower, it cannot be separated from that subvariety by any certain characters, and is itself so much diversified into subdivisional kinds, some of which are identical with cauliflower in every thing but tenderness of habit, that it may fairly be considered as a duplicate of cauliflower in a state of superior acclimatation. It may, therefore, either have been originally introduced from Cyprus along with cauliflower, or have been subsequently educed from that plant in the gardens of France or of England.

Miller mentions, as in cultivation in his day, only two kinds of broccoli, the purple and the white, which he designates *Brassica Italica purpurea* and *Brassica Italica alba*; and he adds, "The two sorts of broccoli I take to be only varieties of the cauliflower; for although these may with care be kept distinct, yet I doubt, if they were to stand near each other for seeds, if they would not intermix; and I am the rather inclined to believe this, from the various changes which I have observed in all these sorts, for I have frequently had cauliflower of a green colour, with flower-buds regularly formed at the ends of the shoots, as those of broccoli, though the colour was different, and the white broccoli approaches so near to the cauliflower as to be with difficulty distinguished from it." The intermixing or confounding of kinds from juxtaposition in seeding, however, proves nothing; for this takes place, in the brassica tribe, not only between two subvarieties or two varieties of one species, but even between varieties of different species. See the article BRASSICA.

The kinds or subvarieties of broccoli now in cultivation are somewhat numerous; and, by ordinary precaution and care in the raising of seeds, they can easily be kept distinct. The principal are the autumnal purple cape broccoli, the autumnal green cape broccoli, Grainge's cauliflower broccoli, winter green broccoli, early purple-headed dwarf autumnal broccoli, late purple large broccoli for main crop, late dwarf purple broccoli for spring crop, branching purple broccoli for main crop, early green broccoli, late green large broccoli for secondary crop, dwarf brown close-headed broccoli, sulphur-coloured broccoli, latest green, Siberian or Spanish broccoli, white or cauliflower broccoli, and cream-coloured or Plymouth broccoli. The two last of these kinds have only one central head, very like that of the cauliflower, nearly as large, more hardy, and scarcely inferior in flavour.

All the kinds are commonly raised from seed; and the several kinds may be so adapted to the different seasons, and to open-ground and frame-sowings, as to afford a succession throughout al-

most every part of the year. Three moderate sowings may be sufficient for most ordinary private gardens, the first early in April, the second late in May, the third in the second week of August, and each with a selection or diversity of kinds suited to its season. When a greater number of sowings is desired, two, of the purple cape and early cauliflower kinds, may be made under a frame, at the end of January and at the end of February, for pricking out in March and April, and for use at the close of summer and in autumn; a third, of the same kinds, on an eastern wall border, in the second week of March, for use in the latter part of autumn; a fourth, of the same kinds, in the open ground in April, for pricking out in May, for planting in June, and for use at the close of autumn and beginning of summer; a fifth, and comparatively extensive sowing, of the early white and purple kinds, in the middle of May, for pricking out in June, and planting in July; a sixth, in the open ground, in June, for pricking out in July, and planting in August and September; and a seventh, under a frame, in the end of August, for planting out in March, and for use in the early part of summer. Each kind must be sown quite separately from any other kinds. The seeds should be sown thin, and covered to no greater a depth than half an inch; and the open-ground seed-beds ought to be not more than between three and four feet in width to admit of easy weeding, and to be covered with a net to prevent devastation by birds. Plants, at pricking out, should have five or six leaves, of somewhat more than an inch in breadth; and should be set at distances from one another of five or six inches, and watered every evening till they strike root. Plants, at final planting, should have leaves of nearly three inches in breadth, and ought to be set at distances from one another of rather more than two feet in summer, rather less in winter, and watered every evening till they become well established. Each growing crop ought to be frequently hoed, and to have the earth drawn up around the lower part of its stem.

Cape broccoli may be produced in a state of high perfection by the following method of cultivation: During the first week of June, in an open and warm situation, mark spots in rows three feet apart and nearly two feet over; dig holes at the spots to the depth of one foot, fill in some rotten dung, and cover this with two inches of soil, so as to leave cavities of four or five inches in depth from the surface; sow the seeds thinly on this, rake in the soil, and dust the surface with soot; and when the plants have risen, remove all from each spot except three of the strongest, and earth up the latter as they advance, and give them water if the season be dry.

One method of protecting the winter-standing crops from the destructive influence of severe weather, is, early in November, to take them up with as little damage as possible to their roots.

and to replace them slantingly in the soil, with their heads to the north. When snow accompanies severe weather, a covering of it artificially heaped over the plants, will protect them from the injurious effects of the frost. Another method of protection, recently brought into use, is, in the first week of September, to make small trenches at the north end of the rows of the plants, to lay the adjoining plants so low in the trenches that the centre of their stems at the top is brought level with the surface of the ground, to give each an immediate watering, and place over its roots an additional covering of soil, and, previous to the first fall of snow, to gather around it a mimic hillock of soil, in order to support its leaves, and prevent them from being broken. Another method of protection is to lay some bean or pea haulm or other litter on the ground among the stems of the plants, to strike the whole plot as full as it will stick of old pea stakes, and thus to place the plants in an artificial coppice,—the litter representing the withered grass, and the pea stakes representing the bushes.

Broccoli, like cabbages, borecoles, and other kinds of brassica with semiligneous stems, may be propagated by cuttings. Truncheons or cuttings may be formed, with each an eye or bud; they ought to be dried, for a few days, in the sunshine, so that they may acquire sufficient exsiccation and hardness to resist early fermentation; and they must be dibbled into the spots where they are intended to remain, and kept in as dry a state as possible, or at least not artificially watered till they show some appearance of beginning to grow. For this mode of propagation, the soil selected for the bed should be light and well-drained, and the day chosen for planting should be dry.—*Mawe.*—*Miller.*—*Loudon.*—*Transactions of the Horticultural Society.*—*Gardener's Magazine.*—*Quarterly Journal of Agriculture.*—*Switzer's Italian Broccoli.*

BROCK. The badger.

BROKEN-KNEES. Wounds in the knees of the horse. They are of very frequent occurrence, in some instances from accidents by obstruction, in others from the faulty management of riders, and in others from unsoundness or stumbling habit in the animals themselves. Wounds in the knees, when inflicted from the first or the second of these causes, may involve not the slightest permanent damage; yet they are so frequently an index to serious unsoundness, that, whenever traces of them exist, intended purchasers ought to make full and careful trial of the animal's action and habit. When the wounds are inflicted, they ought to be very thoroughly cleaned with a sponge and warm water; if they are deep, extensive, or much lacerated, they should be poulticed twice or thrice a-day, for two or three days, with a goulard poultice; and, should they become worse, and emit a thin offensively-smelling discharge, they must be cleansed with a hot detergent lotion, and may possibly require to be

touched with the hot iron. But in all bad cases, professional advice and treatment ought early to be obtained.

BROKEN-WIND. A serious disease in the lungs of horses. It presents considerable resemblance to thick-wind, and is often preceded or immediately caused by that disease; and thick-wind and broken-wind jointly produce a gradation of distressing symptoms to which horse-dealers and farmers have given a series of expressive though inelegant designations. See the article THICK-WIND. Some horses, when very fat, or when violently worked on a full stomach, suffer injurious pressure of the stomach upon the lungs, emit grunting sounds like those of a hog, and are popularly called grunters. Some, more from obstructions in the nose, than from disease in the lungs, puff, blow, and violently distend their nostrils, whenever they are more than very moderately exercised; and these are called high-blowers. Some, from contraction in the windpipe or the larynx, whenever they are for some time smartly exercised, emit a disagreeably shrill sound, and soon become greatly distressed; and these are designated whistlers. Some, when suffering bronchitis, or when permanently afflicted with thick-wind, emit, at all times, a sound somewhat similar to that emitted by an asthmatic human subject, when under slight exertion; and these are designated wheezers. Some, from permanent disease in the lungs, when worked into more than their usual rate of breathing by a little labour, emit a louder and harder noise than that of the wheezers, and are popularly designated roarers; and some of this latter class, owing to contraction in the small passages of the lungs, emit a strong shrill sound in quick breathing, and are designated pipers. But truly broken-winded horses are in a far more diseased condition, and exhibit much more distressing symptoms, than any of these classes.

A cough of a peculiar kind precedes and accompanies broken-wind; it usually begins in the form of a common cough, yet, in many instances, is not observed in its commencement or its early stages; it afterwards becomes chronic, and is accompanied with the symptoms of thick-wind; and it eventually assumes a short, cutted, grunting character, so decidedly peculiar to broken-wind, that a horse-dealer is instantly apprized by it alone of the existence of this disease. The mere breathing of a broken-winded horse, also, is both distressing and peculiar; and exhibits the remarkable phenomenon of two acts of expelling the air for every act of inhaling it. The inspiration is both quicker and more laboured than in a healthy animal; and the expiration is prolonged, elaborate, and painful to both lungs and abdomen. "In the first of the two efforts of expiration, the usual muscles operate; and in the other, the auxiliary muscles, particularly the abdominal, are put on the stretch to complete the expulsion more perfectly; and that being

done, the flank falls, or the abdominal muscles relax with a kind of jerk or spasm." A sudden falling of the flanks indicates that the air is very readily inhaled; and a long continued exertion of the abdominal muscles shows that it is slowly and with great difficulty expelled.

The veterinary surgeons of the last century appear to have generally regarded broken-wind as an undue enlargement of the lungs, and a loss of their elasticity. Lawrence, in particular, taught that the most common appearance of the lungs in broken-winded horses, is a general thickening of their substance, by which their elasticity is in a great measure destroyed, and their weight specifically increased, at the same time that their capacity for air is diminished. Gibson thought that, in consequence of a hasty or injudicious feeding of young horses, the growth of the lungs and all the contents within the chest are so increased as not to have space within the cavity of the chest for the full play of their parts, or the free performance of their functions. "A narrow contracted chest, with large lungs," says another writer of last century, "may sometimes naturally be the cause of this disorder; and it has been observed that horses rising eight years old, are as liable to this distemper as, at a certain period of life, men fall into asthmas, consumptions, and other chronic diseases. The reason why this disorder becomes more apparent at this age, may be, that a horse comes to his full strength and maturity at this time; at six, he commonly finishes his growth in height; after which, he lets down his belly, and spreads, and all his parts are grown to their full extent; so that the pressure on the lungs and midriff is now more increased. But how little weight soever these reasons may have, repeated dissections have given ocular proofs of a preternatural largeness, not only of the lungs of broken-winded horses, but of their heart and its bag, and also of the membrane which divides the chest, as well as of the remarkable thinness of the diaphragm or midriff. This disproportion has been observed to be so great, that the heart and lungs have been almost of twice their natural size, perfectly sound, and without any ulceration whatever, or any defect in the windpipe or its glands. Hence it appears that this enormous size of the lungs, and the space they occupy, by hindering the free action of the midriff, is the chief cause of this disorder; and as the substance of the lungs was found more fleshy than usual, they must of course have lost much of their spring and tone."

But though the lungs of a broken-winded horse are larger than their natural size, they appear to acquire the chief feature of their disease from a ruptured condition of some of their air-cells. Numerous air-bladders occurred on the surface of all which were examined by Mr. White; and these, he thinks, "must have arisen from a rupture of some of the air-cells, for in that case some part of the air which is inspired will neces-

sarily get into the cellular membrane of the lungs, and diffuse itself until it arrives at the surface, when it will raise the pleura so as to form the air-bladders we observe." Mr. Youatt also states that, "in almost every broken-winded horse which he has examined after death, he has found dilatation of some of the air-cells, and particularly towards the edges of the lobes. There has been rupture through the parietes of some of the cells, and they have evidently communicated with one another, and the air could be easily forced from one portion of the cells to another. There was also a crepitating noise while this pressure was made, as if the attenuated membrane of some of the cells had given way. These were the true broken cells; and hence the derivation of the name of the disease."

One cause of broken-wind is constitutional or hereditary tendency to contract inflammatory affections. Another cause is the particular kind of organic conformation, such as narrowness of chest or fragility of membrane, which offers most resistance to a free expansion and a full play of the lungs. Another cause, or rather introduction and almost begun formation, is the disease of thick-wind. A fourth cause is plethora or fulness of habit, occasioning an undue determination of blood to the lungs, an increase of the secretions within the air-vessels, and perhaps the production of acrimony and viscosity in these secretions. But a more frequent cause than any, and one which reflects vast censure upon owners and keepers of horses, is violent exercise while the stomach is distended with water, but especially with dry food. "Horses that are greedy feeders, or devour large quantities of slightly nutritious food, or are worked with a stomach distended by this food," says Youatt, "are very subject to broken-wind. More depends upon the management of the food and exercise than is generally supposed. The post-horse, the coach-horse, and the racer, are comparatively seldom broken-winded. They are fed at stated periods on nutritious food that lies in little compass, and their hours of feeding and of exertion are so arranged that they seldom work on a full stomach. The agricultural horse is too often fed on the very refuse of the farm, and his hours of feeding, and his hours of work, are frequently irregular; and the carriage-horse, although fed on more nutritious food, is often summoned to work by his capricious master, the moment his meal is devoured. A rapid gallop on a full stomach has often produced broken-wind."

A thorough knowledge of the nature and causes of broken-wind is of great importance to every farmer; for, while the disease is both very common and very serious, the only effective means of dealing with it is prevention. Broken-wind might, in the great majority of instances, be fully and easily prevented; but, when once formed, it can never be cured. Yet, in all its ordinary forms, it may be considerably alleviated. When

a horse appears to be in its first stages, he may be moderately bled, and receive a laxative ball; and at all subsequent periods he should be regularly exercised, carefully fed, and sedulously protected from costiveness, and especially from violent exertion. He ought to receive water only in small quantities, yet so often as five or six times a-day; he must never feed on such light and distensive matter as chaff or straw; he may receive sparing quantities of corn and bran; he may eat somewhat freely any kind of succulent food, particularly carrots; he may, in fine days, be turned into a paddock; he must be kept in a clean, well-ventilated stable, free from foul litter and ammoniacal vapours; and he ought, above all things, to have regular and long-continued exercise, and, at the same time, to be carefully kept from all such exertion as would, for even the briefest period, stimulate the action of the lungs.—*White's Veterinary*.—*Lawrence's Enquiry into the Structure and Animal Economy of the Horse*.—*Bartlett's Farriery*.—*Youatt on the Horse*.—*Gibson on the Diseases of the Horse*.

BROME-GRASS,—botanically *Bromus*. A large genus of grasses, of the suborder Glycerinæ. Twelve species grow indigenously in Great Britain; nearly forty species have been introduced from other countries, principally the continent of Europe; nearly twenty other species have been described by botanists; and five species which were formerly included under *bromus*, are now assigned to the genera *brachypodium*, *rostraria*, and *trichæta*.

The rye-like species, *B. secalinus*, is an annual weed of the corn fields of England. It grows to the height of about two feet, and flowers from June till August. The name rye-like alludes to the form of the seeds.—The many-flowered species, *B. multiflorus*, grows wild in both England and Scotland; and has the same height, habits, and duration as the rye-like species. Each spikelet contains from ten to fifteen florets; and hence the epithet "many-flowered." The produce of this species, when in flower, upon a soil of sandy loam, as ascertained in the Woburn experiments, is 22,460 lbs. of grass per acre, and 1,754 lbs. of nutritive matter.—It naturally occurs, in greatest abundance, on poor or exhausted grass lands; and it forms a soft and downy herbage of a kind which cattle do not relish. The soft or downy species, *B. mollis*, is also an indigenous annual of Great Britain. It grows to the height of about two feet, and flowers from June till August. It abounds principally about walls, and on the same kinds of soil and land as the many-flowered species. Its leaves are soft and downy, and not relished by cattle. The produce of it per acre, when in flower, upon a sandy loam, is 10,890 lbs. of herbage, and 510 lbs. of nutritive matter.—The racemose, branched or smooth species, *B. racemosus*, grows wild in the meadows and pastures of England; and has the same habits, height, and duration as the preceding species.—The upright

species, *B. erectus*, is somewhat common on the chalky pastures of England. It is a perennial grass, grows to the height of about three feet, and flowers from June till August. Its produce per acre, when in flower, upon a rich sandy soil, is 12,931 lbs. of herbage, and 555 lbs. of nutritive matter. It has, for a considerable time, been in great request, for lawns upon arid soils; for it forms as thorough a mat or sward as rye-grass, and very powerfully resists the bad effects of aridity.—The rough species, *B. squarrosus*, is a perennial weed of the corn fields of England. It grows to the height of about three feet, and flowers from June till August, but it possesses no interest as a grass.—The rough wood species, *B. asper*, is an annual weed of the moist woods, or moist shady places, of England. It grows to the height of about four feet, and flowers from June till August.—The meadow species, *B. pratensis*, is a perennial weed of the corn fields of England, and grows to the height of about two feet. It is frequently confounded with the upright species.

The field species, *B. arvensis*, is a perennial weed of the corn fields of Britain, and occurs also in many rich pastures and meadows. Its panicle is compound, spreading, and drooping; its spikelets are lanceolate and sharp-pointed; eight imbricated, smooth florets, with two close ribs at each side, constitute each spikelet; the leaves are hairy; and the stem usually grows to the height of about three feet. Its produce per acre, when in flower, upon a sandy loam, is 23,821 lbs. of herbage, and 1,488 lbs. of nutritive matter. Yet though a comparatively unproductive grass, it possesses several recommendations to the store farmer: it affords a little early spring food to sheep; it does not strike deep root, or exhaust the soil; it offers a sturdy resistance to frost; and it readily, and without aid from man, propagates itself from its seeds.—The barren species, *B. sterilis*, is an annual weed of rubbishy spots in England and Scotland, and usually attains a height of about two feet.—The Madrid species, *B. madritensis*, grows wild upon walls in Britain, and is an annual of about 18 inches in height.—The tall or giant species, *B. giganteus*, is ranked as a fescue-grass, and called *Festuca gigantea*, in Smith and Sowerby's English Botany, and in Sinclair's *Hortus Gramineus Woburnensis*; and an agricultural variety of it, popularly termed the three-flowered, is called, in the former of these works, *Festuca triflora*. The root of this species is perennial and ligneously fibrous; its stem is smooth, striated, round, naked, erect, and from two to four feet in height; its leaves are enciform, dark green, and about 18 inches long; and its panicle nods at the top, and has awns somewhat flexuose, and longer than the husks. It flowers from June till August; yet generally ripens its seed toward the close of July. It grows wild principally in woods, and partially in meadows; but it readily adapts itself alike to shady and to open situations, and

everywhere prospers under cultivation. Though a coarse grass, and containing comparatively little nutriment, it is much superior to the spiked and wood species of fescue. A long-leaved variety of this species, *B. g. longifolius*, grows wild on the sea-shores of Scotland, is usually about a foot taller than either the normal plant or the three-flowered variety, and presents some claims upon the cultivator's attention.

The roof species, *B. tectorum*, is a biennial, and was introduced to Britain from the continent of Europe in 1776. It has a nodding panicle, and usually grows to the height of about a foot. Its produce per acre, on a light sandy soil, is 7,486 lbs. of herbage, and 350 lbs. of nutritive matter.—The unarmed or awnless species, *B. inermis*, has a smooth stem and an awnless panicle. Its produce per acre, on a black siliceous sandy loam, is 12,251 lbs. of herbage, and 689 lbs. of nutritive matter.—The pendulous species, *B. pendulinus*, is an annual grass of two feet in height, and was introduced from the continent of Europe in 1817.—The shaggy or maned species, *B. jubatus*, is also an annual grass from the continent of Europe, and was introduced from Italy in 1823.—Two annual species, called Willdenow's and Schrader's, were introduced in 1835.—The clothed species, *B. vestitus*, is a curious greenhouse perennial, brought from the Cape of Good Hope in 1816.—All the other introduced species are hardy, and eleven of them are perennials; but none are worthy of cultivation as agricultural grasses.

BROMELIA. A genus of evergreen herbaceous plants, forming the type of the natural order *Bromeliaceæ*. This order comprises the genera *ananassa*, *agave*, *tillandsia*, *bromelia*, *buonaparteia*, *littæa*, *billbergia*, *caraguata*, *guzmannia*, *furcraea*, *pitcairnia*, and *pourretia*. All are natives either of the tropics, or of countries which have a tropical climate. Four or five species are cultivated in the greenhouses, and about one hundred in the hothouses, of Great Britain. They are remarkable for the dryness, hardness, rigidity, and spininess of their grey foliage. They are exceedingly succulent, generally acidulous, and, in many instances, epiphytal, forming vast and dense festoons among the trees of tropical forests. The flowers of most are pretty, and either white or blue; and those of some are remarkably beautiful and fragrant. The eatable pine-apple is the most useful; and the other genera differ from this, far less in general appearance, than in the simple want of a fleshy fruit. The most beautiful genera are *bromelia* and *billbergia*; and the most interesting are *agave* and *tillandsia*.

Upwards of a dozen species of the genus *bromelia* have been introduced to Britain. The two species which have been longest in cultivation, *B. Pinguin* and *B. Karatas*, were brought from the West Indies, the former in 1690, and the latter in 1739. The leaves of the one are very like some species of aloes, but not so thick or succulent, and sharply indented on their edges, and

armed with strong black spines. The flower-stem rises from the centre of the plant to the height of about three feet. The lower part of the stem is garnished with entire leaves, growing alternately from the joints; and the upper part is decorated with a loose spike or thyrsæ of flowers. The leaves of the other old species are shorter than those of the former, sharply serrate on the edges, and of a deep green colour. The flower-stem rises from the centre of the plant, which divides upward into several branches; and the upper parts of these are garnished with spikes of flowers, which come out alternately from the side of the branches, each having immediately below it a narrow, entire leaf, longer than the spike.—The sweating species, *B. exsudans*, is an epiphyte; and all the others are self-rooted herba. The height of the plants of the several species ranges from one foot to four feet; and the colours of the flowers are variously green, red, crimson, pink, purple, and yellow. One of the most recently introduced species is the two-flowered, *B. discolor*.

BRONCHITIS. Inflammation of the lower part of the windpipe. It is a frequent and very serious disease in both horses and cattle. It does not appear to be ever contagious; but it is very evidently epidemic,—sometimes attacking flocks in the same general manner in which they are, at other times, attacked by catarrh or by inflammation in the lungs. But, in most instances, it is preceded by catarrh, originates in a downward course of the inflammatory action of the disease, and may therefore be ascribed to the neglect or the inefficient treatment of catarrh. It very seldom has a sudden formation; but is usually preceded by a comparatively long course of coughing and other premonitory symptoms which afford a careful overseer ample warning to use proper means for averting it. The usual symptoms of bronchitis in both the horse and the ox, are interrupted whizzing in respiration, a variable coldness in the extremities, a harder and more rapid pulse than in either catarrh or the first stages of inflammation of the lungs, a respiration as rapid as the pulse and sometimes more rapid, a haggard and anxious look, an evident fear of suffocation, and an obstinate reluctance to move. A variety of bronchitis which often proves fatal to great numbers of young cattle is accompanied with some remarkable symptoms, and seems to be chiefly caused by parasitical insects. See the article *FILARIA*. Bronchitis ends sometimes in suffocation, and more frequently in incurable inflammation of the lungs. The grand remedies for it are blistering and bleeding; and subordinate ones are gentle action on the bowels and nice adaptation of food. But it is far too serious a disease to be dealt with by any person but a skilful regular practitioner.

BRONCHOCELE. An enlargement of the two glands which are situated below the larynx and

attached to the windpipe of the horse. It offends the eye of an observer, but does not seem to cause much pain to the animal, or to deteriorate his value. It may be attacked by a blister or by iodine ointment.

BRONCHOTOMY. See TRACHEOTOMY.

BROOD-MARE. See MARE, and HORSE.

BROOKLIME. See BECCABUNGA.

BROOKWEED,—botanically *Samolus*. A small genus of evergreen herbaceous plants, of the primrose tribe. Valerandis' species, *Samolus valerandi*, grows wild in gravelly marshes in Great Britain, and is also found in New South Wales and in other parts of the world. It grows with us to the height of about nine inches, and carries a white flower from June till August. It formerly bore the popular designation of round-leaved water pimpernel. Two greenhouse species, the sea-side and the campanula-like, have recently been introduced from respectively New South Wales and the Cape of Good Hope; and the latter is called by Thunberg *Campanula porosa*.

BROOM,—botanically *Cytisus*. Several species of branching shrubs, of the genista division of the leguminous tribe, and formerly belonging to the genus *Spartium*, but now included in the genus *Cytisus*. The common broom, *Cytisus scoparius*, formerly *Spartium scoparium*, belongs to the same subdivision of *Cytisus* as the laburnum, but is strictly shrubby and very profusely branched. It grows abundantly as a weed in the dry commons and neglected pastures of Britain; it is extensively sown on hilly grounds as a shelter for game; and on account of its delicate flowers, its flat hairy pods, and especially its curious appearance, it is frequently admitted into shrubberies and gardens. Were it a rare exotic, instead of being an abundant and troublesome weed, it could not fail to be highly esteemed by all florists, amateur-cultivators, and landscape-gardeners. Its usual height is about six feet; its branches are angular, vertical, slender, very numerous, very flexible, and coated with a delightfully green bark; the leaves of the lower part of the branches are trifoliate, and those of the upper part are single; the flowers are papilionaceous, have a brilliant yellow colour, appear from April till July, stand upon short footstalks, all along the sides of the last year's shoots from top to bottom, and so completely adorn each twig as to give the whole shrub a look of magnificence beyond most of the flowering tribe; and its pods are compressed and hairy, and contain kidney-shaped seeds.

The branches of this plant, as well as those of other brooms, are very often cut and made into sweeping-brooms; and they are extensively employed also for thatch. The stringy fibres may be used for making a kind of ropes, and seem to have been employed by the ancients as a substitute for flax. The flowers yield a very large amount of honey to bees. Mr. Bradley calculated

long ago that an acre of broom is worth six pounds a-year for the feeding of bees alone, and will produce, in addition, a sufficient value of withes and stumps to pay the rent. The green twigs contain a comparatively large proportion of carbonate of potash and other alkaline salts, and therefore might be used to fertilize many of the barren knolls on which they abound. The tops and the green branches have a peculiar odour and a bitter nauseous taste; and an infusion of them acts medicinally as an emetic, a diuretic, and a purgative, and in certain cases of dropsy, but is injurious in case of inflammation. The whole plant is cultivated on some poor soils in the south of France, for the manufacture of a kind of coarse thread from the fibres of its bark. It is cultivated in various parts of the continent, also, as a winter food for sheep, and has been recommended for cultivation, on poor soils in England, as food for both sheep and horses. But it clearly affords far less nutritive matter than other kinds of forage which might be produced on the same soils; and it has the very serious disadvantage of acting powerfully on the urinary organs of all animals which eat it.—The white flowering variety of the common broom, *Cytisus scoparius albus*, grows to the same height as the normal plant, and is very commonly cultivated in gardens and shrubberies for its beauty.

But broom figures chiefly as a pernicious weed, and must be regarded as one of the most troublesome plants which infest pasture lands. It strikes its roots deep into the soil, it continually sucks moisture from the earth, it makes no compensation by returning its leaves to act as manure, and it sheds its seeds, not only in great profusion, but with habits of springing into growth at periods so distant as six or seven years. One method of destroying it, is to burn the land, to plough it deep, and to manure it richly with dung and ashes, or with calcareous matter and urine. Another method, when the land is designed for pasture, is to cut the broom close to the ground in May, when it is full of sap, and, in consequence, to arrest its circulation, to prevent its further formation of cambium, and to occasion the starvation and death of its roots. Another method is to pull up all young plants, by hand-weeding, when the ground is saturated with rain; yet this method is successful only when the texture of the soil and other circumstances are decidedly favourable to the complete extraction of all the radicles. Another method is to fodder cattle upon broomy land; for their urine corrodes the roots of the plants, and their treading of the land diminishes its adaptation to both the spreading and the absorption of the roots.

The thorny broom or prickly cytisus, *Cytisus spinosus*, formerly *Spartium spinosum*, was introduced to Great Britain from the south of Europe, toward the close of the 16th century. It is a small evergreen shrub; its branches are numer-

ous, slender, tough, and armed with long spines; its flowers have a bright yellow colour, stand on long footstalks at the ends of the branches, appear from April till July, and make a very ornamental appearance; and its pods are short, hard, and thickened towards the upper suture.—Another species, which has been called by some botanists *Spartium spinosum*, and by others *Spartium villosum*, and *Calycotome villosa*, but which is now more generally and appropriately known as *Cytisus laniger*, was introduced from Spain in 1821. It is similar in appearance to the thorny broom, and, like it, has prickly branches, yellow flowers, and pods thickened towards the upper suture.

The cloud-born broom or white retama, *Cytisus nubigenus*, formerly *Spartium nubigenum*, was introduced, in the latter part of last century, from Teneriffe. Its usual height is about six feet; its branches are unarmed; its leaves are few in number; and its flowers are white, and appear from May till June. Its habit is half tender. A rambling but curious notice of it in the Philosophical Journal of December 1826, says, "The honey made by the bees upon the Peak of Teneriffe has long been celebrated. Every village in the neighbourhood in the month of May carries its bee-hives, which are hollow stems of the dragon-tree, and places them in the crevices of the rocks. Millions of bees then swarm around the large and fragrant white bushes of the white retama, and very soon fill their hive. The honey is taken from them twice every summer, always in great abundance; and neither Hymettus nor Chamouny has ever produced anything equal to it, it is so pure and transparent, and the taste so aromatic and delicious. Whoever, indeed, would import this bush to the bees of Europe, would deserve as well of his countrymen as he who introduced the vine and fruit-trees; and this would be by no means difficult, for spartium grows perfectly well here, where snow lies almost continually from December till the middle of April, and even where the lowness of the temperature checks the vegetation of every kind of tree. It might thrive extremely well in the interior of Norway, in Austria, and Poland. But no one has been hitherto successful in rearing it in Europe; and everything that has been said of its flourishing in botanical gardens is erroneous."

The white Portugal broom, *Cytisus albus*, formerly *Spartium multiflorum*, was introduced from Portugal about the middle of last century. It resembles, in most of its characters, the cloud-born broom; but has a much hardier habit, and grows unprotectedly in the open ground in England. It has white flowers, and a very ornamental appearance. A variety of it with flesh-coloured flowers, *C. a. incarnatus*, was recently introduced from Portugal. Two other species from Portugal are the spreading and the large-flowered, *C. patens* and *C. grandiflorum*, formerly

Spartium patens and *Spartium grandiflorum*.—*Loudon, Marshall, Miller*.—*Bradley's Husbandry*.—*Mill's Husbandry*.—*The Farmer's Magazine*.—*Jamieson's Philosophical Journal*.

BROOM,—botanically *Spartium*. A genus of shrubby leguminous plants, of the same family as cytisus. It is now restricted to three species, but was formerly of very considerable extent. Seven or eight species at present growing in Great Britain, and formerly belonging to it, are now assigned to the genus cytisus; about twenty, to the genus genista; and two, to the genus adenocarpus.

The rush or Spanish broom, *Spartium junceum*, was introduced to Great Britain from the south of Europe, about the middle of the sixteenth century. It is a much superior plant to the *Cytisus scoparius*, both as an ornamental shrub, and for the various economical purposes, whether of forage or manufacture, to which the common broom is applied. It usually grows to the height of six feet, and may easily be made to attain the height of ten. Its branches taper, grow in opposites, and are covered with a smooth green bark; its leaves have a fine green colour and a spear-shaped outline, but are few in number; its flowers have a yellow colour, are produced in loose spikes at the ends of the branches, and bloom from July till September; and its pods are compressed and contain kidney-shaped seeds. The fibre of the Spanish broom is manufactured into a very good cloth, by the inhabitants of Spain and the south of France. The flax of it is prepared by boiling the twigs or most vigorous shoots of the preceding year for about an hour in water, or by steeping them two or three weeks, according to the heat of the season, in a pond. The flax, after this preparation, may be freely peeled or stripped off either by machinery or by hand; and it then requires only to be well washed in cold water, well wrung and shaken, and hung out in the open air to dry. The twigs, after being stripped of the flax, and boiled for some time in water, become tough and beautifully white, and are an excellent material for the manufacture of carpet brooms and some other articles.

A double-flowered variety of Spanish broom, *S. j. flore pleno*, has the same height, habit, root, leaves, and other characters as the normal plant, but produces very full double flowers, and does not bear any pods. The flowers seldom appear till August, and are much less numerous than those of the single variety.—The sweet-scented broom, *Spartium odoratissimum*, was introduced from Persia in 1834; but is regarded by some botanists as only a variety of the Spanish broom.—The sharp-leaved species, *Spartium acutifolium*, was recently introduced from Turkey.

BROOM,—botanically *Genista*. A large genus of shrubby leguminous plants, forming the type of the subtribe genisteæ. No fewer than thirty-two genera are included in this subtribe; but at

once the best-known and the most nearly allied of these are *spartium*, *cytissus*, and *ulex*. Three species of the genus *genista* are natives of Great Britain, nearly fifty have been introduced from foreign countries, and about twenty other species have been scientifically described.

The dwarf English broom, or English petty whin, *Genista anglica*, is an evergreen shrub, of about two feet in height. It grows wild on moist heathy grounds in many parts of Britain; yet has many beauties to recommend it to the gardener. Its branches are spiny; its leaves are small, simple, lanceolate, and alternate; its flowers have a fine yellow colour, are produced in clusters at the end of the branches, and appear in May and June; and its pods are thick and short.

The dyer's broom, or woodwaxen, or dyer's greenweed, *Genista tinctoria*, grows wild in the dry pastures of England and Germany. It has a height of about three feet; its branches are tapered and channelled; its leaves are lanceolate and alternate; and its flowers are yellow, small, and so profusely numerous as to cover nearly the whole shrub, and they appear from June till August. One variety of this species has a comparatively narrow leaf and upright habit, and another has a broader leaf and a more spreading habit.

The branching broom or pilose greenweed, *Genista pilosa*, grows wild on some sandy heaths of England, and is a native also of France, Germany, and Hungary. Its usual height is about six feet; its branches are slender and very spreading, and decline towards the ground; its main stem is all over beset with tubercles; its leaves are obtusely spear-shaped; and its flowers have a yellow colour, are produced in spikes at the ends of the branches, appear in May and June, and flourish in such profusion as to make a charming show.

The single-seeded broom, *Genista monosperma*, formerly *Spartium monospermum*, was introduced from the south of Europe, near the end of the 17th century. The common yellow variety of it has a height of about six feet; its branches are tough, angular, and numerous; its leaves are lanceolate and few; its flowers have a fine deep yellow colour, are produced in bunches from the sides of the branches, appear in June and July, and are so numerous as to render the whole plant brilliant; and its pods are short, and contain each but one seed. The white-flowered variety requires a dry soil, and a well-sheltered situation. Its branches are slender, tough, numerous, tapering almost like rushes, and covered with a whitish bark; and its flowers are similarly produced to those of the other variety, but have a white colour.

The prickly or scorpion broom, *Genista scorpius*, formerly *Spartium scorpius*, was introduced from the south of Europe in 1570. Its usual height is about four feet; its stem is woody; its

branches are few, slender, prickly, and branching; its leaves are oval, smooth, and, in some varieties, hairy; and its flowers appear in March and April, are moderately large, and vary, in the several varieties, from a deep to a pale yellow.

The starry broom, *Genista radiata*, formerly *Spartium radiatum*, was introduced from Italy about the middle of last century. It usually grows no higher than about 18 or 24 inches; but it occupies a very large space proportionately to its height, extending itself all around to some distance. Its branches are flexible and very narrow, and grow opposite by pairs; its leaves are trifoliate and opposite; its folioles are awl-shaped, and radiate from a centre like the radii of a star; and its flowers have a bright yellow colour, are produced in small clusters or spikes at the end of the branches, and appear in June and July; and its pods are short and hairy, and contain a few kidney-shaped seeds.—Four of the remaining introduced species of *genista* have spiny branches and trifoliate leaves; four have spiny branches and simple leaves; ten or eleven have unarmed branches, and principally trifoliate leaves; and between twenty and thirty have unarmed stems and simple leaves.

BROOM,—botanically *Lygeum*. An anomalous kind of grass, belonging to the Linnean class *Triandria monogynia*. Only one species of it is known; and this is designated *Lygeum spartium*. It is a native of Spain, and was brought thence to England in the latter part of last century. It grows to the height of about 18 inches, and flowers in May and June. It is exceedingly flexible; and is employed by the Spaniards for making ropes, baskets, and other useful articles.

BROOM (BUTCHER'S),—botanically *Ruscus*. A genus of small, ornamental, evergreen, shrubby plants, of the *smilax* tribe. The prickly species, *Ruscus aculeatus*, grows wild in the thickets of England, France, and Italy. It has usually a height of only about a foot, but rises, under good cultivation, to a height of three feet. Its root is large, white, tender, and creeping, and strikes very deeply into the ground; its stems are ligneous, tough, green, and streaked; its leaves are oblong, entire, thick and stiff, of a dark and dusky green colour, with prickly points as sharp as needles, and grow alternately on the stems; its flowers are small and greenish, grow on the middle of the upper surface of the leaves, and appear from June till December; and the fruit of the female plant consists of sweetish, beautiful red berries, about the size of pease. The roots and berries possess diuretic properties, and have been much used in medicine. The young shoots, gathered in spring, may be eaten like asparagus or hop-tops, and are much relished by some persons, but have diuretic properties and a very bitter taste. The whole plant is gathered by butchers, and made into besoms for sweeping their blocks and shops; and hence it obtained the name of butcher's broom. A variety of this

species, called the loose, *R. a. laxus*, was introduced to Britain from Portugal, and has the same height and general appearance as the normal plant, but flowers from January till June. Another variety, called the round-leaved, *R. a. rotundifolius*, flowers in March and April.

The broad-leaved, or leaf-under-leaf species, *Ruscus hypophyllum*, was introduced from Italy about the middle of the 17th century. Its roots are large and white, and have long thick fibres; its stems are numerous, tough, very elastic, of a fine green colour, and about the same height as those of the prickly species; its leaves are oval, longer and broader than those of the prickly species, of a thick consistence, of a very fine shining green colour, ending in acute points, and growing alternately on the stems; its flowers are small and greenish white, grow near the middle of the under surface of the leaves, and appear in May and June; and its berries are small and red, and ripen in winter.—A variety of this species called the trifoliate, *R. h. trifoliatum*, was brought to Britain from Zante, and has been considered by some botanists a separate species.

The under-tongued species or hypoglossum, *Ruscus hypoglossum*, is considerably smaller than the two preceding species, and can claim a place only in the very fore-ground of a shrubbery. It was brought from Italy near the close of the 16th century.—The racemose species or Alexandrian laurel, *Ruscus racemosus*, is a native of Portugal, and usually attains a height of four or five feet. The knotted, the twining, and the hermaphrodite species are evergreen climbers from the Cape of Good Hope and the Canary Islands, and require greenhouse culture.

BROOM-RAPE,—botanically *Orobanche*. A genus of evergreen parasitical plants, forming, with the small genus *Lathræa*, the natural order *Orobanchææ*. All the species of the order consist of leafless parasites, with brown or colourless scaly stems or flowers, and growing on the roots of the plants to which they are attached. The name *orobanche* is derived from two words which signify 'to strangle a vetch;' and it sufficiently indicates the general habit of the genus. Upwards of thirty species have been scientifically described; and three of these infest the farm-fields of Britain, occasioning trouble and loss to the farmer, while four others grow wild in other situations in our country, and constitute objects of curiosity to our botanists.

The taller species, *Orobanche elatior*, grows in clover fields, has a height of about 20 inches, and carries a yellow flower in July and August. The smaller species, *O. minor*, grows also in clover fields, has a height of only six or seven inches, and carries a yellowish white flower in July and August. The branchy species, *O. ramosa*, grows in hemp fields, has a height of about a foot, and carries a brownish purple flower in August and September. The blue species, *O.*

cærulea, grows on the sea-coast, has a height of about six inches, and carries a violet-coloured flower in July. The red species, *O. rubra*, grows on rocky places in Ireland, has a height of six or seven inches, and carries a purple flower in August. The greater species, *O. major*, grows in waste places, has a height of about twenty inches, and carries a brown flower in June and July. The clove-scented species, *O. caryophyllacea*, has a height of about a foot, and carries a dingy purple flower.

The greater species, though usually growing on wastes, may be viewed as a fair type of all the British species. It loves to cling to the common broom, and seems to have obtained from that circumstance the popular name of broom-rape; and it not unfrequently, in common with the taller and the minor species, attaches itself to plants of cultivated clover. It resembles, in its early growth, the sprouting of asparagus; its stems are furnished with a kind of bractes instead of leaves; its flowers have a spiked arrangement somewhat similar to those of the hyacinth; and its seeds grow in oblong capsules, but are so minute as to be scarcely discernible by the naked eye,—and they attach themselves to the seeds of clover by a sort of glutinous exudation, and are, in consequence, sown with these seeds, so as to send up shoots in parasitical attachment to the roots of clover. Broom-rape is said to possess some medicinal properties, particularly as a strong astringent.

BROOM (SPANISH). See **BROOM**—*Spartium*.

BROSIMUM. See **BREAD-NUT**.

BROUSSONETIA. A genus of small, ornamental, deciduous trees, of the order *Urticææ*. The paper-bearing species, *Broussonetia papyrifera*, was formerly ranked as a mulberry, and called scientifically *Morus papyrifera*, and popularly the paper mulberry. It is a native of Japan, and was introduced thence to Great Britain about the middle of last century. It usually grows to the height of from 12 to 30 feet. Its leaves are very large; some are entire, and others are divided into several lobes; and all have a fine strong green colour on their upper surface, and a paler green on their under surface. Its flowers are dioecious and apetalous, and appear from February till September; and the female flowers are succeeded by small black fruit. It is cultivated in large plantations, in Japan and China, for the manufacture of paper from the bark of its young shoots; the plants are headed to within about a foot of the ground; and every year the bark of the summer's shoots is peeled off from the whole of the plantations.—The spatulate-leaved species, *Broussonetia spatulata*, was introduced about twenty years ago, and grows to about the same height as the other species. Both are finely ornamental.—Two species of tender evergreen trees of the *Maclura* or *Osage-Orange* genus, have been included by some botanists in the genus *Broussonetia*.

BROWN. A dusky dark brick colour. Brown horses vary in the shades of brownness, from light to very dark; but, as a class, they are reckoned not so beautiful as bay or chestnut horses. Almost all have black manes and tails; many have black joints, though of a rustier and less shining hue than those of the bays; many also are light-coloured about the muzzle; and most have a shading off into lightness of colour towards the belly. Many are coarse, yet strong and serviceable, fit for burden, for draught, or for the saddle. The most beautiful are a few which happen to be finely dappled.

BROWN BENT. See *AGROSTIS*.

BROWN STOUT. Strong brown beer, brewed from brown high dried malt.

BROWSE. Such succulent spray and twigs of shrubs and trees as are eaten by cattle.

BRUCEA. A genus of tender, evergreen, ornamental shrubs, of the turpentine-tree family. The rusty ash-leaved species, *Brucea ferruginea*, was brought from Abyssinia in 1775, and named Brucea in honour of the celebrated Abyssinian traveller; and two other species, the slender and the Sumatran, were introduced about twenty-five years ago from the East Indies. They usually grow to the height of from six to ten feet; and they require stove-house culture.

An important vegetable alkali takes from this genus of plants the name of brucea, and was discovered by Pelletier and Caventon soon after their discovery of strychnia. It was obtained from a bark which they erroneously supposed to be that of one of the species of Brucea; and it has since been obtained from St. Ignatius' bean, from the bark of the false angustura, and from the bark of *Strychnos nux vomica*. It is bitter and poisonous, and resembles strychnia, but is twelve or sixteen times less energetic. It consists, according to Liebig, of 70·88 per cent. of carbon, 6·66 of hydrogen, 5·07 of nitrogen, and 17·39 of oxygen. The chief salts of brucea are the nitrate, the muriate, the sulphate, the phosphate, the oxalate, and the acetate; and all these are bitter, and, with the exception of the phosphate and the acetate, are crystallizable. Brucea is powerfully medicinal; and, when better known, may possibly become a valuable remedy in certain cases of paralysis, diarrhoea, and cholera.

BRUGMANSIA. A genus of splendidly ornamental tender plants, of the nightshade tribe. It is very closely akin, in all botanical characteristics, to the datura or thorn-apple genus; but differs from the plants of that genus in being ligneous and perennial. The sweet-scented species, *Brugmansia suaveolens*, formerly called *Datura arborea*, is one of the most gorgeous inhabitants of the British greenhouse, and has of late years been so acclimated as to take its station in the open ground, in the same manner as bouvardias, verbenas, cinerarias, and other mere winter inmates of the greenhouse. This superb

plant was introduced to Britain from Peru in 1733, and was long treated as one of the most tender beauties of the stove. "It rises with a woody stalk," says Miller, "to the height of 12 or 14 feet, dividing into several branches, garnished with oblique leaves, 6 inches long, and 2½ broad in their broadest part, growing narrower at each end; they are oblique to the footstalk, which stands nearer to one side than the other; they are downy, and stand on long footstalks. The flowers come out at the division of the branches; these have a loose tubular empalement, near 4 inches long, which opens at the top on one side like a spatha or sheath, within the empalement; the tube of the flower is narrow, but immediately above it swells very large for near 6 inches in length, then spreads open at the brim, where it is divided into five angles, which terminate in very long points; they are white, with some longitudinal stripes of a pale yellow on their outside; these are succeeded by round smooth capsules, filled with kidney-shaped seeds." This plant has, for a very long period, been carefully cultivated by the Chilese; and, for some years past, has become a well-deserved and very high favourite with the most tasteful and scientific class of British gardeners. It can be so cultivated as to bloom through all the summer and most of the autumn, and to be covered at one time with a perfect canopy of flowers; it displays a most imposing contrast between the rich green of its ample foliage and the delicate whiteness of its large pendulous bells; and it throws around it such a cloud of exquisite fragrance as to fill a conservatory or even a garden with its perfume. A variety of it called the yellow-flowered, *B. s. flava*, is distinguished principally by having its flowers of a sulphur colour.

The white-stalked species, *Brugmansia candida*, is frequently confounded with the sweet-scented species, and seems to have shared with it the old botanic name of *Datura arborea*. This species was introduced from Peru in 1813; and it has similar habits to the sweet-scented species, and produces also white-coloured flowers, but usually grows to only about two-thirds of the height.—The two-coloured species, *Brugmansia bicolor*, but called by some botanists *Brugmansia sanguinea*, was introduced from Peru in 1833; and possesses high attractions in the magnificence of its flowers and foliage, and considerable interest in the chemical principles of its seeds. Its stem is arboreous, and about twelve feet in height; its branches are short and leafy; its leaves are dark green above and paler below, from two inches to twelve inches in length, alternate, ovate, oblong, waved and scolloped, with short blunt lobes; its flowers are produced singly from the forks of the branches, and are funnel-shaped, seven inches in length, green towards the base, orange-yellow further on, a deep orange scarlet in the five-lobed limb,—and this last colour, lessened in intensity, extends down the

tube till it blends with the orange-yellow, while this, in its turn, extends downward to a blending with the green; and the capsules which succeed the flowers are oblong, smooth, yellow, pendulous, and about eight inches in length. This remarkable plant is a native of cold and elevated districts in the provinces of Tarima, Xauxa, Huarochesi, Canta, and Humalies, and also between Almaquer and Pasto in New Granada. It prefers to grow among rubbish, and has been found at altitudes above sea-level of nearly 7,000 feet. The Colombians call it Bovochevo; and the Peruvians, Floripondio encarnado and Campanillas encarnadas. Its seeds, like those of stramonium, are highly narcotic. The priests of a famous oracle, in a temple in the city of Sogamoza, intoxicate themselves with these seeds, on the same principle on which the Pythoness at Delphi is said to have brought herself under an afflatus by inhaling gas and chewing the hydrocyanous leaves of the laurel. A drink called Tonga is prepared by the Colombians from the capsules; and this, in small doses, acts as a soporific, but, in large doses, produces a kind of frenzy which can be overcome only by administering immediate draughts of cold water.—*The Botanical Register*.—*The British Flower-garden*.—*The Hortus Britannicus*.—*Loudon's Gardener's Magazine*.—*Miller's Dictionary*.

BRUISE. An injury to an animal, occasioned by the percussion or abrasion of some sharp or heavy object. A recent bruise in a horse may be cured principally by fomentations; but a very severe bruise may involve considerable inflammation, and requires poulticing, moderate bleeding, and the administration of a laxative ball. Blood may be let either from the vicinity of the bruise or from the toe. If a bruise be followed by abscess, and the discharge of fetid, dark-coloured, purulent matter, the horse must be internally supported by plentiful feeding with corn, or, if possible, by some feeding with malt; and if he lose appetite, he must be drenched with good water gruel and strong infusion of malt, and receive once or twice a-day a cordial ball. Such stimulating topical applications as camphorated spirit and oil of turpentine, may also be of eminent service. If a bruise be followed by a hard callous swelling, an embrocation composed of $\frac{1}{2}$ oz. of camphor, 1 oz. of oil of turpentine, and $1\frac{1}{2}$ oz. of soap liniment, should be rubbed well into the part twice a-day; and if the swelling still continue, a blister must be applied. The proper treatment of bruises in the ox is very similar to that of bruises in the horse. Bruises are not common in sheep,—the wool generally serving as a protection; but when they do occur, they may almost always be reduced by hot fomentations.—*White, Clater, Spooner*.

BRUISING CORN. The trituration or mechanical preparation of grain for the feeding of horses. Without disintegration, either by means of trituration by machinery or mastication by the

teeth, or a combination of the two processes, seeds taken into the stomach of animals retain their vitality, resist the reducing action of the gastric juice, withhold from the absorbents their alimentary principles, and pass through the canals of the viscera nearly in the same manner as hard mineral substances which cannot be organically assimilated. Some persons contend that, when grain is to be employed as food for horses, it ought simply to be cut or broken by the common millstone or with grooved rollers; and others contend that it ought to be so thoroughly bruised as to suffer entire destruction of its organic structure. When horses are fed partly on moist food, the mere breaking of the grain may be sufficient; but when they are fed on hay and corn, bruising by means of plain rollers seems to be far preferable. When grain is completely crushed, it not only escapes the risk of passing through the system unchanged, as always happens with a portion of such feeds of it as are given unbroken, but it readily yields to the solvent power of the gastric juice, and so easily surrenders itself to the whole process of assimilation as to economize the organic efforts of the animals in reducing it.

Machines of various kinds are used for bruising corn, some driven by hand, and some worked by horse or steam power. Such as are driven by hand have the convenience of being portable; but they occasion a considerable and uneconomical expenditure of labour. Every corn-bruising machine, therefore, ought to be worked by a power in connexion with the thrashing-machine, or, where this is not convenient, by a single horse power. A very simple kind of bruising-machine for hand-power consists of only one roller, with the grooves running parallel to the axes, and made to work against an obliquely grooved plate. Other kinds have been constructed with two rollers, the one having the grooves running parallel, the other obliquely to the axes. A good model hand-machine, in the Museum of the Highland Society, consists of a pair of small cylinders, the one smooth, the other obliquely channelled, and the latter revolving with greater velocity than the former; and this machine prepares oats partly by bruising and partly by cutting, and is also well adapted for bruising beans or pease, and may, for this latter purpose, be advantageously applied to horse-power. In all the well-working hand-power bruisers, the grooves are cut in the form of saw-teeth, having their distance between the cutting-edges about one-fifth of an inch, the depth of the grooves about one-sixteenth of an inch, and the obliquity of the grooves to the plane of the axes of the roller at an angle of about 10° . The grooves are so arranged that, if the rollers are laid side by side, the obliquity of both runs in one direction; and hence their cutting-edges, as they work in the machine, look in opposite directions, and cross each other in every act of revolution, at an angle of about 20° . On the prolonged axle of the

roller whose cutting-edges look downward is fixed a pinion of eight teeth; on that of the other roller is fixed a wheel of twenty teeth, driven by the pinion; the cutting-edges of the pinion-roller move in a descending direction, and with $2\frac{1}{2}$ times more speed than those of the other roller; and the grain, in passing between the two sets of cutting-edges is cut as with a series of scissors, and, in consequence of the shallowness of the grooves, is held so close to them that it cannot escape their cutting action. A fly-wheel is hung upon the axle of the first roller; and as a feeding-roller, driven by a motion from the former, is placed above and between the two cutting-rollers, it is usually of the same diameter as these, and formed with six or eight longitudinal semicylindrical channels, three-fourths of an inch wide, and three-eighths of an inch deep; and these receive the grain from the bottom of a hopper placed over the feeding-roller, and deliver it in due succession to the cutting-rollers. Moveable bushes are constructed to contain one of the cutting-rollers; and these can be so shifted and adjusted by screws as to suit the kinds and quality of the grain, and the degree of fineness to which it is to be reduced.

When grain is damp, it clogs grooved rollers, and cannot be efficiently cleared away from the grooves; but it possesses less adherence to plain rollers, and can easily be cleared away from them by means of permanent scrapers. A machine with plain rollers has been supposed to require more labour than one with grooved rollers, and hence has by some persons been thought less useful; but besides being of superior efficiency in performing its office, it may, if properly constructed, be really worked with at least equal ease. A good machine of this description may, with moderate labour, be so worked by one man as to prepare a boll of oats in an hour and a half. The standard of a well-constructed one consists of two frames of cast-iron, with bars of $2\frac{1}{2}$ inches in breadth and five-eighths of an inch in thickness, and measuring all over 26 inches at bottom and 19 inches at top. The frames are put together with malleable iron stretchers, and secured with screw-nuts; and, when bolted together, they have a width of 17 inches at bottom and 8 inches at top. The side-frames have at bottom projecting palms, for increasing the base; and, at top, small palms or snugs for attaching the roller-case to the standard. "The roller-case consists of two cheek-plates, into which the entire bushes are inserted for the axles of the rollers; the cheeks are held together by four bolts, which also secure the ends of the case; a pinion of eight teeth is fixed upon the axle of the feeding roller, and gives motion first to the wheel of 24 teeth, set upon the axle of one of the bruising-rollers, which may be called the driver. The diameter and position of the two bruising-rollers are each seven inches in diameter, and seven inches in length, while the feeding-roller is only four

inches in diameter. On the opposite ends of the axles of the bruising-rollers, each roller is mounted with a wheel of 16 teeth, working into each other, thus making both rollers move at the same velocity, while the feeding-roller moves three times faster. The handle or winch is fitted to the pinion or feeding-roller, the fly-wheel being mounted on the opposite end. The second or driven roller is supported on moveable bushes, and can be adjusted by the pinching-screws to produce any degree of fineness required. For the regulation of the feed, a plate is bolted on, and forms the top of the roller-case; it is formed with a prismatic channel equal in length to the roller, $2\frac{1}{2}$ inches wide at top, and at bottom opens into a slit $\frac{1}{4}$ inch wide, parallel to the rollers. Two moveable shutters are adapted to the upper part of this opening, and are capable of being set at any distance, according to the degree of feed required; which can be determined by the operator after a few turns of the handle. The hopper, made of deal, is secured in a temporary manner by means of two hooks and eyes to the top of the machine; and the spout, fixed to the standard, carries the bruised grain from the rollers, and delivers it into a measure or basket."

The bruising machines which are driven by water, steam, or horse-power, are so simple in construction and in mode of working as not to require any lengthened description. Almost all consist of plain rollers or cylinders of cast-iron, accurately turned in the lathe, and varying from 12 to 24 inches in length, and from 6 to 12 inches in diameter. A few are so awkwardly and uneconomically constructed as to have a length of only about 6 inches, and yet a diameter of two, three, or even four feet. All perform their work simply by their rollers being kept in rapid motion, and by the corn being supplied from a hopper, and bruised by passing between the rollers. The velocity of the machines, when they are moved by a sufficient power, may average about 300 feet per minute; and a pair of rollers, when worked by four horses, will bruise about 120 bushels per hour.

BRONZE. An alloy of copper, with tin, zinc, &c. Two kinds may be distinguished, Antique and Modern bronze, the former consisting of copper and tin, the latter containing zinc, in addition to copper and tin, or sometimes containing no tin. Modern bronze may therefore be brass with an excess of copper. The principal objects of bronze are cannon, bells, statues, and medals, the principles of manufacture in all being similar.

Taking bronze in a more limited sense, as consisting of copper and tin, it has the following general properties. It is harder and more fusible than copper; it is slightly malleable, when it contains over 85 per cent. copper, and becomes more so by tempering; it oxidizes very slowly in moist air. Its density is greater than the mean density of its constituents. The addition of about 1 per cent. of iron, or rather of common tinned iron

(sheet-tin), is found to make a harder and more tenacious bronze, for small objects, but appears to be of little benefit to objects of larger size. Larger quantities of zinc may be added to bronze with the same results, as is often done in statue-bronze, bells, &c. A small quantity of lead may be added, but it rather diminishes the valuable properties of bronze, rendering it more susceptible to oxidation, and tending to separate towards the bottom of a large casting.

Bronzing.—When bronze is exposed for a great length of time to atmospheric agents it assumes a peculiar greenish or olive hue, arising from the formation of a basic hydrated and carbonated oxide of copper, or a dark olive hue from sulphuret of copper. Being an attractive colour, numerous experiments have been instituted to discover a method of obtaining the same result in a short time. It is usually effected by means of a salt of copper, mixed with other salts, dissolved in water or weak acids, and applied to the surface with a brush, or the objects are immersed in the solution. Two pts. verdigris and 1 pt. sal-ammoniac are dissolved in vinegar, boiled, filtered, and much diluted, and the medals, &c., immersed in the solution until they acquire the desired colour, when they are washed. Binoxalate and bitartrate of potassa are employed with sulphate, nitrate, or acetate of copper. After attaining the bronze-colour, the objects should be thoroughly washed in pure water, with repeated washings, to remove every trace of salts or acids, and thereby prevent the surface from farther change. Different tints may be imparted to bronze, from a reddish to a light yellow, by acting upon it with acids and salts, by which either copper or zinc may be extracted. Thus, boiling muriatic acid extracts a considerable quantity of tin before attacking the copper. Mixtures of saltpetre, common salt, and sulphuric acid, may be made to extract either copper or the white metals, and thus the colour may be varied.

Tinning copper.—This depends upon the affinity of copper and tin, whereby a small quantity of the latter is fixed upon the surface of the former. The important principle in tinning is that the surface of the copper be clean and perfectly free from oxide, and be so maintained during the process. This is attained either by the use of sal-ammoniac or resin, with melted tin, or by cream of tartar in solution and grained tin. The sal-ammoniac is either dissolved and brushed over the surface of the copper, or it is heated and its vapour condensed on the surface; tin is then introduced, melted, and rubbed over the surface with tow. The process with resin is conducted in a similar manner. Tinning with sal-ammoniac is more durable, but requires the use of nearly pure tin; tinning with resin allows the employment of an alloy of lead and tin. The quantity of lead should never exceed $\frac{1}{4}$ or $\frac{1}{5}$ of the tin, as it might otherwise prove detrimental to those employing food prepared in such vessels.

Tinned vessels, whether containing lead or not, are not to be recommended in place of good bell-metal, certainly not for the preparation of food, especially if the latter be acid, or the vessel is to be heated.

Whitening pins.—Copper or brass is easily tinned in the wet way. Thus, in the pin manufacture, when they are completely formed, they are cleansed in a pickle of sulphuric acid, vinegar, cream of tartar, &c. They are then thrown into a copper vessel, stratified with grained tin, covered with water, cream of tartar added, and the whole boiled. The cream of tartar probably acts by dissolving a portion of tin, and then transferring it to the pins, which, containing zinc, become electric by contact with tin.

Imitation of Bronze.—The pigments and varnishes are applied to the surface of wood, plaster, &c. The objects to be bronzed are first covered over smoothly with a coat of size or oil-varnish, and when nearly dry, the metallic powder made from Dutch foil, gold leaf, mosaic gold, or precipitated copper, is applied with a dusting-bag, and then rubbed over the surface with a linen pad; or the metallic powders may be mixed with the drying oil beforehand, and then applied with a brush. Sometimes fine copper, or brass-filings, or mosaic gold, are mixed previously with some pulverized bone-ash, and then applied in either way. A mixture of these powders with mucilage of gum arabic is used to give paper or wood a bronze appearance. The surface must be afterwards burnished. Copper powder precipitated by clean plates of iron, from a solution of sulphate or nitrate of copper, after being well washed and dried, has been employed in this way, either alone or mixed with pulverized bone-ash. A finish is given to works of this nature by a coat of spirit-varnish. The iron-coloured bronzing is given by black lead or plumbago, finely pulverized and washed.

BRUNIA. A genus of small, evergreen, ornamental, greenhouse shrubs, forming the type of the order *Bruniaceæ*. This order comprises seven genera; and has, in the gardens of Great Britain, about seventy species. All are small heath-like shrubs, highly ornamental in both flowers and foliage; and, with the exception of one from Madagascar, all are natives of the Cape of Good Hope. They differ from the currant tribe by having dry fruit; from the Escalloniæ, by having few seeds; from the Rhamnaceæ, by having a minute embryo; and from the Umbelliferæ and the Araliaceæ, by their not having their flowers in umbels. Their nearest affinity is to the currant tribe. About twenty-five species of the genus *Brunia* have been brought to Britain from the Cape of Good Hope; and most of these have a height of about two or three feet, while all produce white flowers in summer. Several other and quite recently introduced species have been assigned to four other genera.

BRUNSFELSIA. A genus of tender, ever-

green, ornamental shrubs, of the nightshade tribe. Only four species are known; and all have been introduced to Britain. The American or longest-known species, *Brunfelsia americana*, was brought from the West Indies in 1735. Its stem is ligneous, sends out many side branches, and usually attains a height of from four to ten feet; its branches are covered with a rough bark; its leaves are oblong-oval and entire; its flowers are produced in threes and fours from the end of the branches, have a pale yellow colour, and are almost as large as those of the greater convolvulus; and its fruit is soft and round, and encloses, in a state of adherence to its skin, many oval seeds. This plant grows wild in most of the Sugar islands of the west, and is there called the trumpet-flower.

BRUNSVIGIA. A genus of bulbous plants, of the amaryllis tribe. Upwards of a dozen species are known to botanists, and all are natives of the Cape of Good Hope, and have been introduced to Great Britain; but about one half were formerly included in the genera amaryllis, amموcharis, and hæmanthus. Most have a height of about 12 or 15 inches, and produce flowers of some shade of red, between pink and scarlet. One of the most esteemed species for ornamental purposes is *Brunsvigia Josephinae*; and this produces scarlet flowers from June till August, and comprises two principal varieties, the minor and the striated. One of the species, *Brunsvigia toxicaria*, formerly *Hæmanthus toxicarius*, is popularly called the poison-bulb, and yields a viscid poisonous juice, with which the Hottentots poison their arrows; and another of the species, *Brunsvigia coranica*, formerly *Ammocharis coranica*, is popularly called the Coranic poison-bulb, and has also poisonous properties.

BRUSHWOOD. Masses, thickets, and coppices of indigenous shrubs and dwarfed trees. Brushwood is sometimes identified with the lopings and clearings of woods for fuel, and sometimes with browse-wood or such twiggy and succulent growth of timber-plants as is suitable for consumption by cattle; but it is more appropriately, and far more generally, made to signify thickety masses, whether small or great, of native ligneous plants. Brushwood, thus understood, consists of all kinds of indigenous trees, growing stintedly, irregularly, and neglectedly, and wanting some economical member, such as the bark of the oak or the twig of the osier, to render them remunerative to the proprietor or the tenant of the soil; and it particularly includes dwarfish and amassed plants of the birch, the poplar, the alder, the mountain-ash, the hazel, the thorn, the lime-tree, the willow, and the holly.

In many districts, brushwood occupies large aggregates of land in such a manner as to be both unsightly to the eye, and useless to the tenant or proprietor; and in some, it so completely covers many choice or naturally fertile tracts of soil, as to render them incapable of

producing any tolerable quantity of herbage, and, at the same time, to prevent them from being georgically improved. When it is kept low by cattle browsing on its shoots as they rise, and is systematically consumed as part of their regular food, it benefits live stock, partly by the shelter which it affords, and very greatly by the nutriment which it yields; but when it is allowed to become so old and hard as to be unfit for browsing, it ought either to be exterminated from all fertile lands, or converted to some profitable use on such lands as cannot afford the cost of its extermination.

One general and easy mode of rendering all brushwood profitable, is to select such plants as promise to rise into useful and ornamental forest timber, and to cut down all the rest for conversion into charcoal. A great extent of land at present almost useless, might either be thinned into valuable forest, or cleared into profitable meadow or pasturage, dotted with the choicer trees; and the charcoal manufactured from the ejected brushwood might be remuneratingly applied in iron-works, in gunpowder-works, and in various other ways. Brushwood may also be advantageously used, in its smallest as well as largest parts, for common fuel, and for constructing the roofs of cottages; and it may be employed likewise for making dead-fences around fields and plantations, wattles or hurdles in outbuildings, temporary wears for sheep and cattle, and, in some instances, baskets, hampers, and numerous small articles of both utility and ornament.

"The extension of the herring and butter trades, and the introduction of the circular saw," remarks Mr. Blaikie, "have operated very favourably in raising the value of alder and other underwoods, and opened an ample field for disposing of them. These saws may be attached to a thrashing-mill, should there be one in the neighbourhood; and, if not, portable ones may be constructed at small expense, to be impelled either by water, by horses, or by human power. As there can be no doubt that the demand for small staves will be great and increasing, it would be a likely speculation to raise both alder and birch in situations where there is no chance of rearing oak and more valuable timber to perfection, for that purpose alone. To allude to the making of packing-cases, as opening a demand of any extent for the consumption of poplar, may at first sight appear to many to be fanciful and ridiculous. But those who are best acquainted with the American timber trade will admit that, before the late stagnation, large quantities of yellow pine were sold as high as from 1s. 10d. to 2s. per foot, to be so employed, at most of the principal ports of Britain." Important hints as to the higher uses to which the several kinds of brushwood may be turned, occur in our articles on the respective indigenous trees of Great Britain. See also the articles COPPICE and BARK.

BRUSSELS SPROUTS. A subvariety of the

cabbage plant. It is often regarded as belonging to the same subdivision of the cabbage species as the borecole, or *Brassica oleracea acephala*; but it is more correctly placed by De Candolle in the same subdivision as the Savoy cabbage,—and while the latter is botanically designated *Brassica oleracea bullata major*, the Brussels sprout-plant is designated *Brassica oleracea bullata gemmifera*. This subvariety has very numerous sprouts; it is raised every year from seed sown in March or April; it is planted out in summer, at distances of two or three feet between the plants; and it is earthed up at the approach of winter. Its habits and appearance are a sort of medium between those of the common borecole and those of the Savoy cabbage.

BRYONY,—botanically *Bryonia*. A genus of twining plants, of the gourd or cucumber family. One species grows wild in Great Britain; upwards of twenty species have been introduced from the four quarters of the world; and about forty other species have been scientifically described. Two of the species in Britain, the dioecious and the white, are hardy, and all the others are more or less tender; one, the roughish, is an annual, and all the others are perennials; these three species are deciduous, and all the others are evergreen; about a dozen of the species have either subangular or palmate leaves, and most of the others have lobate leaves.

The dioecious species, *Bryonia dioica*, is indigenous in many parts of Britain, and loves to grow on dry banks, under hedges, and in thickets. It has tendrils and foliage somewhat like the vine, and climbs around bushes and trees, usually to the height of from eight to twelve feet. Its root is white, rough, and large; its leaves are hairy, broad, and lobate; its flowers are small and whitish green, and bloom from May till September; and its berries are red and full of seeds. Impostors, in former times, forced the growing roots of this plant into the human shape, carried them about the country, and exhibited them to the staring credulity of the common people under the name of mandrakes. To achieve this purpose, they selected a thriving young plant, carefully opened the soil all round it without disturbing its lower fibres, cautiously adjusted to the root a mould used for making plastic figures, fastened this with a wire to keep it firm in its place, and then filled back the soil, and left the root to grow to the shape of the mould; and when they performed this process in March, they usually found the root as they wished it in September. The root has such powerful properties as a stimulant, an emetic, and a purgative, as to be poisonous in moderate quantities, and strongly medicinal in very minute doses. The symptoms which it produces somewhat resemble those of spasmodic cholera. Many persons have been grievously injured and even rapidly poisoned by using bryony root upon the prescription of herbalists. The administration of this

mighty drug to young horses is pronounced by Youatt "one of the abominable secrets of the horse-breaker." A state of artificial excitement and condition is produced by it; and when this passes away, as it speedily does, the animal suffers a sad diminution, either temporary or permanent, of vital power. "We have," says Youatt, "occasionally traced much mischief to this infamous practice." Slices of bryony root, placed in the pans or feeders of strawberry pots, and covered lightly with moss, act as powerful decoys to aphides; so that a few pans of them, placed four or five successive nights in the beds, frames, and other places infested with these insects, will attract the whole of them, and bring them completely into the gardener's power, to destroy them in a half pailful of boiling water. A peculiar bitter principle, called bryonin, is obtained from the root of the dioecious bryony. The French call the root the Devil's turnip. A preparation of this plant, or of *Bryonia alba*, makes a prominent figure among the medicines of the homœopaths.

The white species, *Bryonia alba*, has a similar habit and similar medicinal properties to the dioecious species; and was introduced to Britain about forty years ago, from the continent of Europe.—The great-flowered species, *Bryonia grandis*, was introduced from the East Indies in 1783. It grows to the same height as the two preceding species, and blooms from May till August. The natives of India use its leaves as a potherb, and eat its ripe fruit as a dessert. The fruit is smooth, oblong, and about an inch and a half in length; and has a mawkish sweetish taste.—The ground or umbel-flowered species, *Bryonia epigæa*, was introduced from India about 30 years ago, and is probably the most important of the several species whose properties are known. Its stem is sulcate, smooth, and about two feet in height; its leaves are somewhat fleshy, cordate, trilobate, dentate, and rough; and its flowers form a raceme or umbel,—the male flowers five and small, and the female flowers single, pedunculate, and proceeding from the same axilla as the male flowers. The root, as sold in the bazars of India, is of various thickness and length, has a bitterish subacid taste, and is partially marked with whitish, raised, circular rings. It is considered by the physicians of India as anthelmintic and deobstruent; but is employed principally in forming a liniment with siragum, onions, and castor oil, for chronic rheumatism and contracted joints. "I must remark," says Dr. Ainslie, in his *Materia Medica of Hindostan*, "that it is mucilaginous and tonic, stomachic and aperient, and that the natives employ it, in consequence, with success in the latter stages of dysentery; they also give it internally for old venereal affections and chronic rheumatism. The root, when dried, very much resembles in taste the Colomba root, to which it also approaches in medicinal qualities." Three

Indian species, which do not seem to have yet been introduced to Britain, *rostrata*, *scabra*, and *callosa*, are likewise used by the natives for medicinal purposes; and the first and second of these are used also as potherbs, while the bitter seeds of the third are administered for some diseases of horses, and likewise yield a fixed oil which the poor people consume in their lamps.

BRYONY (BLACK).—botanically *Tamus*. A small genus of hardy, deciduous, dioecious, twining plants, constituting of itself a tribe or order in the Jussieuan system. The plants have large tuberous roots, heart-shaped leaves, and racemes of small axillary flowers. The common species, *Tamus communis*, grows wild on the sides of hedges in various parts of England. Its root is fleshy and very large, and has a dark brown skin or cover; its stem is smooth and twining, and usually rises to the height of ten or twelve feet; its leaves are heart-shaped, lucid green, and alternate; its flowers are produced in long racemes from the side of the stems, and appear from May till August; and its berries are oval, smooth, and red. The Cretan species, *Tamus cretica*, was discovered in the island of Crete by Dr. Tornfort, and sent thence to Britain in 1739. Its root is rounder than that of the common species; its stem has a height of only about five or six feet; and its leaves are three-lobed.—The roots of both species are purgative and dangerous; and the whole plant of the common species is medicinal.

BRYOPHYLLUM. A curious greenhouse plant, of the houseleek or crassula tribe. It constitutes of itself a genus, and takes for its specific name *calycinum* or large-cupped; but it was formerly classed as a navelwort, and called *Cotyledon calycinum*. It was brought to Britain, about 46 years ago, from the East Indies. It possesses the remarkable property of budding from the margin of its leaves, and takes from this circumstance its botanical name, which signifies a leaf-plant. Its leaves are succulent, oblong, and sometimes pinnated, and have a deeply crenelled border; and when placed in a warm, moist, shady situation, they form buds and young plants from their crenels. The flowers have a greenish-purple colour, are large and pendulous, grow in panicles, and appear from May till July. The whole plant has usually a height of about two feet.

BUBON. A genus of plants, partly herbaceous and partly shrubby, of the umbelliferous order. But it is one of the most unsettled genera in the whole circle of systematic botany; and all the species assigned to it by one class of botanists are distributed by others among the genera *athamanta*, *seseli*, *selinum*, *serula*, and *galbanum*. One of the species longest and most steadily regarded as a bubon is the Macedonian, *Bubon macedonicum*, called by Sprengel *Athamanta macedonica*, and popularly Macedonian parsley. Its root grows almost horizontally, and spreads near

the surface of the ground; its leaf-stalks grow numerous from its root, and ramify into subordinate leaf-stalks; its leaves are smooth, rhomb-shaped, serrated, and of a bright pale green colour; its flower-stem rises from the centre of the plant to a height of about two feet, and ramifies into numerous pedunculous branches; its flowers are produced in umbels at the ends of the branches, have a whitish or pale yellow colour, and appear from June till August; and its seeds are oblong and hairy, and ripen in autumn. This plant was introduced from Greece to Great Britain toward the close of the 16th century; and it is a true biennial in its native country, but does not seed in Britain till the third or fourth year after sowing.—Several of the species are gummiferous, and emit an odour precisely similar to that of the gum galbanum of our drug-shops; and one of these has been very generally, indeed almost universally, regarded as the source whence that gum is obtained. See the article **GALBANUM**. The gum-bearing species, *Bubon gummiferum*, is an economical plant of the Cape of Good Hope, and was introduced thence to Britain in the third decade of last century. It is an evergreen shrub of seven or eight feet in height, and produces pale yellow umbelliferous flowers in July; and it requires with us to be cultivated in the greenhouse. The gum-bearing variety of the stiff-leaved species, *Bubon rigidum gummiferum*, was introduced from the Crimea about 40 years ago; and it is a biennial of about three feet in height, and bears pink flowers from July till September. The galbanum species, *Bubon galbanum*, called by Sprengel *Selinum galbanum*, is an evergreen, tender shrub, of about six feet in height, and was introduced from the Cape of Good Hope toward the close of the 16th century. The buchtorn species, *Bubon buchtornense*, called by Hornemann *Athamanta rigida*, is a recently introduced ornamental Siberian biennial. The other species possess little interest.

BUBROMA. See **BASTARD CEDAR**.

BUCHU.—botanically *Diosma crenata*. A small, evergreen, medicinal and ornamental shrub, of the order Rutaceæ. Some botanists assign it to the genus *agathosma*, and some to *baryosma*, but most to *diosma*. Its flowers are axillary and solitary. Its leaves, which are the parts employed in medicine, are produced in nearly a verticillate manner, on the extreme twigs of the shrub; they are petiolate, and sometimes opposite, but most frequently alternate; they have a leathery consistence, a pointedly ovate-lanceolate form, and a crenated margin; they are about an inch long and half an inch in extreme breadth; and they have a smooth and beautifully bright green upper surface, and a pale and translucently glandular under surface. When dried, they appear to an inexperienced eye to be exceedingly similar to the leaves of senna; they emit a strong and not unpleasant aromatic odour;

and when chewed, they yield first a mint-like taste, and next a mingled sensation of pungency and sweetness. They are tonic, sudorific, and diuretic, and have been found useful in cases of rheumatism, chronic catarrh, inflammation of the bladder, and retention of urine. The Dublin Pharmacopœia orders their exhibition in the form of both tincture and infusion.

BUCKBEAN, — botanically *Menyanthes*. A small genus of perennial, herbaceous, aquatic plants, of the gentian tribe. The three-leaved species, *Menyanthes trifoliata*, grows wild in turbaries, marshes, and other moist places, in many parts of Britain; and, on account of the character of its habitat, is often popularly called bog-bean, and has been described by us under that name. See the article **BOG-BEAN**. The ingenious author of two interesting 'Essays on Husbandry,' published in 1764, says, respecting this species, "Buckbean is a plant of an unsavoury taste; and sheep, when sound and in health, always avoid eating it. But when the symptoms of the rot begin to attack them, they search for it by instinct, and devour it greedily. Where such sheep are pastured, no buckbean is to be found; for, in a week or two, they devour it all. Might it not be prudent, therefore, in husbandmen who graze large flocks, to cultivate an acre of these plants in some morassy ground, which otherwise would not yield them two shillings the acre! Some might be cut up green for unsound sheep, and given them with lucerne, as occasion requires; and some might be made into hay, and mixed with their fodder." An American species, *Menyanthes americana*, was introduced to Great Britain in 1818; and this is so similar to the British species as to have been mistaken for it by Michaux.

BUCKLER-MUSTARD, — botanically *Biscutella*. A genus of hardy, herbaceous, ornamental plants, of the cruciferous order. Nearly thirty species are known to inhabit the south of Europe and the Levant; and most of these are cultivated in the gardens of Great Britain. The ear-podded species, *Biscutella auriculata*, grows naturally in the south of France and Italy, and was brought to Britain in the latter part of the 17th century. It is an annual. Its stem usually rises to the height of about 18 inches, and divides into several branches; an oblong and slightly indented leaf garnishes each joint of each branch; and the flowers have four obtuse pale-yellow petals, and are produced in loose panicles at the ends of the branches. — The Apulian species, *Biscutella apula*, is also an annual, and was introduced from Italy in the early part of last century. Many oblong, hairy, slightly indented leaves grow from the root; a hairy branching stem rises from among the leaves to the height of about 20 inches, has an oblong indented leaf at each joint, and ramifies into several branches; and a close spike of pale yellow flowers is produced from the end of each branch, and appears

in June and July. — All the other introduced species bear yellow flowers; most have a height of about 12 or 18 inches; one is a biennial, one is a herbaceous evergreen, seven have perennial roots, and all the others are annuals.

BUCK'S-EYE-TREE. See *Æsculus*.

BUCKTHORN, — botanically *Rhamnus*. A genus of shrubby plants, forming the type of the order Rhamnæ. This order comprises eighteen genera, and has, in the wilds and gardens of Britain, one hardy herbaceous species, upwards of fifty hardy ligneous species, about ninety greenhouse species, and upwards of thirty hothouse species. It differs from the order Celastrinæ, or staff-tree tribe, in minute botanical characters of the stamens, sepals, and ovary; but wholly agrees with that order in habit, and does not widely differ from it in medicinal properties. Both the fruit and the inner bark of very many of the species of rhamnæ are emetic and purgative; but the fruit of some is a wholesome and agreeable dessert, while that of most yields valuable green and yellow dyes. — Two species of the genus *rhamnus* grow wild in Great Britain; about thirty-five species have been introduced from countries of both continents, or of nearly all parts of the world; and about fifteen other species have been described by botanists. One of the British species is the topic of our article **ALDER (BERRY-BEARING)**; and the most ornamental of the hardy introduced species is described in the article **ALATERNUS**.

The purging species, *Rhamnus catharticus*, grows wild in woods and hedges near brooks in England. Its stem is woody, rigid, strong, ramified, and about sixteen feet in height; its branches are alternate and round, and terminate each in a spine; its leaves are ovate, nerved, serrated, fascioled, and on footstalks, and the younger ones are downy; its flowers are four-cleft and greenish-yellow, grow from the same buds as the leaves, and bloom in May and June; and its berries are small, round, black, four-seeded, and about the size of pease. The berries are very succulent, and yield by pressure a deep green juice; and both they and this juice were formerly much used by the human physician as a hydragogue purgative, and a syrup prepared from them still figures in the pharmacopœias. The juice is sometimes administered by farriers in combination with other purgatives, but is really a useless medicine for the horse; yet, when combined with castor-oil and syrup of poppies, it seems to be beneficial in the disease called red-water in cattle. The inspissated juice, combined with an alkali, constitutes the well-known pigment called sap-green. — One variety of *Rhamnus catharticus*, called the dwarf buckthorn, attains a height of only about three feet, and has small and nearly oval leaves, and irregularly growing branches; and another variety, called the long-leaved dwarf buckthorn, is a larger shrub than the preceding, and has longer leaves.

The olive-like species, *Rhamnus oleioides*, was introduced from Spain about the middle of last century. Its stem grows to the height of eight or ten feet, and sends out numerous spine-terminating branches; its leaves are small, oblong, obtuse, entire, veined, smooth, and of a thick consistence, and grow two or three together on their own separate footstalks; its flowers are small and whitish-green, and come out from the sides of the branches in spring; and its berries are round, black, and about the size of those of the purging buckthorn. The theezan-tea species, *Rhamnus theezans*, is an evergreen shrub of about a foot in height, a native of China, producing green flowers in May and June; and its leaves are used as a substitute for tea by the poorer classes of the Chinese.—The small-leaved and the Surinam species are hothouse evergreens, from respectively Mexico and Surinam; the glandular, the entire-leaved, the winter-berry, the celtis-leaved, the crenulate, and the four-angled species, are greenhouse evergreens from the Canaries, Teneriffe, and the Cape of Good Hope. Clusius', the alaternus, and the dyers' species are hardy evergreens; and all the other species are hardy deciduous shrubs. But the quondam Christ's-Thorn species now constitute the small genus *Paliurus*; and some other species have been removed to three other genera.

BUCKTHORN (SEA), — botanically *Hippophae*. A small genus of hardy and ornamental low trees or tall shrubs, of the oleaster family. The European species, *Hippophae rhamnoides*, is a native of the sea-shores of England and of most other maritime countries of Europe. Its stem usually attains a height of about twelve feet; its branches are numerous, irregular, and dark-brown, and are thinly armed with long and powerful spines, similar to those of the common buckthorn; and its leaves are long, narrow, entire, sessile, somewhat like those of rosemary, dark green above, hoary below, and fading away into a light brown before their fall in December. In winter, the young shoots of the preceding summer are thickly set on all sides with large, turgid, uneven, scaly buds, of a darker brown than the branches themselves; and they give the tree so curious an appearance as to make it arrest every person's attention, and to be as much inquired after as the choicest shrub in the nurseries. In February, the turgid buds have a comparatively great size; and a little before their opening, if the tree be struck with a stick, they will discharge a yellow dust somewhat similar in appearance to flowers of sulphur. The timber has a brittle texture, and a bright brown colour.—The willow-leaved species, *Hippophae salicifolia*, was introduced from Nepaul about twenty-four years ago; it grows to only two-thirds of the height of the common species.—The species formerly called Canadian sea-buckthorn is now assigned to the genus *Shepherdia*.

BUCKWHEAT,—botanically *Polygonum*. Sev-

eral annual and cultivated species, of the polygonum genus or dock tribe. The principal species is *Polygonum Fagopyrum*, called *blé noir* and *blé sarrasin* by the French, *miglio* by the Italians, *trigo negro* by the Spaniards, *buckweizen* by the Germans, *brank* by the farmers of Norfolk and Suffolk, and, *par excellence*, buckwheat by the educated classes of Great Britain. The German name *buckweizen* signifies beech-wheat, and alludes to the resemblance which the seeds of *Polygonum Fagopyrum* present to beech-mast; the British name buckwheat is a corruption of the German *buckweizen*; the name wheat alludes to the similarity of the ground seeds to the flour or farina of wheat; and the French name *sarrasin* is a corruption of the old Celtic name *had-razin*, which signifies 'red corn.' The generic botanical name *Polygonum* alludes to the angular shape of the seeds; and the specific botanical name *Fagopyrum*, like the German popular one, alludes to the similarity of their appearance to beech-mast. The plant is so extensively diffused as, in spite of obviously possessing the properties of an exotic, to be usually classed as a native of England and of many other countries of Europe. It is supposed by some writers to have been introduced from the Levant by the crusaders, and, by others, to have been brought from Africa by the Moors into Spain. Its stem is strong, cylindrical, reddish, branching, and about two feet in height; its leaves are ivy-shaped and alternate; its flowers have a pink or reddish colour, are produced in bunches at the ends of the branches, and begin to make a beautiful appearance soon after the plant rises above the ground, and continue to bloom in a succession throughout the months of July and August; and its seeds are black, angular, and nearly tetrahedral, and ripen through a succession of periods corresponding to the successive bloom of the flowers. It is so tender in its young state that the slightest spring frost completely destroys it, and so far from being hardy in even its mature state that a night-frost in the end of September or early in October destroys the principal part of a crop. Yet the grain of it, when fully set, sustains not the slightest injury from frost; and whole crops of the grain, in good condition, have been carried off the field after every leaf of the plants has perished. To compensate also for its tenderness of habit, the plant grows with such rapidity as to yield a full harvest of grain only three months after being sown; so that though it cannot be safely sown in many parts of England till about the middle of June, it ripens the principal or largest average of its seeds in September, and is then in a state of the most profitable readiness to be reaped.

The Tartarian species, *Polygonum tataricum*, was introduced to Great Britain from Siberia a little after the middle of last century. Its stem is taller and more slender than that of the common species; its flowers have a whitish-

pink colour, and bloom throughout July and August: and its seeds are easily distinguishable from those of the common species by their having toothed edges. It ripens more quickly, has a hardier habit, and is less likely to suffer damage from cold summers or from the inclemency of mountainous districts, than the common species; and is therefore generally preferred by the farmers of Switzerland, Piedmont, and some other alpine countries. But its flowers have an irregular and straggling order of blooming; its flour is blackish and rather bitter; and its quantity of produce, in the estimation of Von Thaer—though not in that of some other celebrated agriculturists—is inferior to the quantity yielded by the common species. The Piedmontese farmers give the name of *Formentine de Savoie* to *P. Fagopyrum*, and the name of *Granette* or *Formentine de Luzerne* to *P. tataricum*.—The notch-leaved species, *Polygonum emarginatum*, was introduced to Great Britain from China near the end of last century. Its flowers are pink-coloured, and flourish in July and August; and its seeds are much larger than those of *P. Fagopyrum*, and have larger and notched wings. It is cultivated in Nepal; but when grown in our climate, a considerable proportion of its flowers are abortive.—The cymose species, *Polygonum cymosum*, was introduced to Great Britain from Nepal about twenty years ago. Its seeds are larger, thicker-skinned, and more winged and flattened on the sides than those of *P. Fagopyrum*.—A species called *Polygonum odoratum*, is said by Loureiro to be everywhere cultivated in Cochin-China as an esteemed vegetable for eating with broiled meat and fish; but this species does not seem to have yet been introduced to Britain.—A new species or variety is noticed in the *Bulletin des Sciences Agricoles* of April 1831, as having been sent by M. Kausler to the Agricultural Society of Wurtemberg, for trial in their experimental gardens. This species or variety was popularly known as *Le blé d'Italie sauvage*, and had for some years been preferred to the common buckwheat on account of suffering less damage from the weather, yielding a larger produce, and affording a whiter and better-tasted flour. Its flower is smaller and more deeply coloured than that of *P. Fagopyrum*.

Buckwheat is much better suited for warm light lands than for cold heavy soils; and is nowhere so certain or uniform a crop as oats or barley. It is exceedingly sensitive to climate, suffers comparatively great damage from fickleness and frequent changes of weather, and, under a variable climate, such as that of most districts of England, yields, under any amount of circumstances of soil and culture, an exceedingly variable produce. In countries which enjoy a genial and steady climate, and which have a poor light soil unsuitable for oats and not strong enough for barley, buckwheat possesses such

surpassing value as to be capable of affording a chief and regular means of support to the whole population. It is, therefore, cultivated as a principal crop in portions of Nepal, Cochin-China, Piedmont, the south of France, and other countries of similar soil, elevation, and climate; as a secondary crop, in Switzerland, Belgium, and many parts of Germany; and either not at all, or only as an occasional and very fitful crop, in almost every agricultural district of Great Britain and Ireland. Yet its eminent adaptation to sandy and semiarid soils obtains for it a recognised and systematic place in the complicated rotations of the Netherlands,—commands high attention to it in the light lands about Berlin, particularly between Werneiche and Welsickendorff, Lewenberg, Steinbeck, and Wollenberg, so far as to the forest about Freyenwalde,—and even occasions it to be regularly cultivated, to a moderate extent, in Norfolk and Suffolk. But, except in these two English counties, it has never obtained much attention in Britain. Patches of it which occur in other districts are usually of small extent, unconnected with systematic husbandry, and designed principally to encourage pheasants and other kinds of game. Yet, as will fully appear from a consideration of its culture, uses, and adaptations, it might, with great advantage, be systematically cultivated in all the drier and warmer districts of England, and would probably be remunerating in even such parts of Scotland as the light sea-board lands on the mutual border of the counties of Haddington and Edinburgh.

Buckwheat is much more suitable for varying well-established rotations, and stimulating their weak-points, than for occupying a place in them as one of their regular members. It is often peculiarly advantageous at a point when land is over-exhausted by the previous crops of a rotation, and cannot be duly recruited with manure for the succeeding crops; and, when thus employed, especially in a dry and warm season, it not only leaves the land in a better condition than oats would leave it, but yields a more valuable return of produce. When any prime soil, under one of the richest rotations, cannot be thoroughly tilled and cleaned for the reception of spring barley, it may most advantageously be withheld from the intended barley, and subjected to another month's cleaning and mellowing in preparation for buckwheat; for it may derive from this month's tillage all the benefits of a summer's fallow,—and, should the season prove dry and warm, it will yield a crop of buckwheat nearly equal in money value to a crop of barley,—and, in the following growths, it will most probably produce a far larger volume of grass and clover, as sown with the buckwheat, than if they had been sown with barley. Buckwheat, when sown properly or thinly with grass seeds, has neither so suffocating an effect as barley upon the young grass-plants, nor robs them so

mightily of the tender nourishment which they need from both soil and atmosphere, but does little else than afford them sufficient protection from the scorching rays of the sun. Even as a mere shade to fallow-land, buckwheat can perform important service. A fallow has frequently been ascertained to suffer sensible deterioration from naked exposure to the summer sun; and, when well managed, under the most improved husbandry, it receives the benefit of some kind of shade. A covering with boards, slates, or tiles preserves its humid wealth; and, when this cannot be obtained, some kind of crop is raised which will not rob the wheat,—and, in particular, yellow clover, folded off by sheep before wheat seed-time, has been found decidedly advantageous. But buckwheat, whether to be ploughed down as a dressing for the wheat, or intended as a grain-crop for harvesting in October, is both so exceedingly rapid in growth, and so extremely succulent in habit, as to be particularly suitable as a shade; and it would, at the same time, be in itself a supernumerary crop, on good, clean, light, land, between winter tares and winter wheat. Arthur Young, in his 'Survey of Suffolk,' mentions this as a successful and strongly recommended practice; and Mr. Rham, in the 'Penny Cyclopædia,' observes, "By this means, the root-weeds which had been smothered by the tares, and ploughed up immediately after the tares were off, will not have time to spring up again; the rapid growth and the shade of the buckwheat effectually keep them down, and prevent the annual weeds from going to seed; thus, a crop is obtained between the tares and the wheat, and the land is kept perfectly clean." Another important purpose which buckwheat may serve in a rotation, particularly as a preparation for the first crop of turnips, is to be ploughed into the ground as manure; but this will be more appropriately noticed in a subsequent paragraph.

When buckwheat immediately precedes a grain crop, and is itself harvested as a grain crop, the stubble of it ought, with all possible despatch, to be ploughed in; for, in consequence of the length of time during which the grain remains on the ground to dry, a considerable quantity of it is shed; and if this were left unmolested till the sowing of wheat or other grain, it would spring up in the capacity of a rank and mischievous weed. But when a ploughing is given immediately after the removal of the crop, all the buckwheat seedlings are in a few days above the ground; and when the manure is spread, and a second ploughing is given, all these seedlings and all other young growths are destroyed, leaving the land quite clean for the reception of the wheat.

Land intended for buckwheat is generally a foul stubble, and ought, as soon as the business of wheat-sowing is completed, and before the commencement of severe frost, to receive a good ploughing; and, in order that it may be mellow-

ed by frost and snow, it should lie in the rough ploughed state throughout the winter. But every precaution must be used to prevent stagnation of surface-water; and, in particular, care should be taken to make clean and deep furrows between the ridges, and, where necessary, cross furrows, with proper judgment, according to the situation of the land. When the important and busy work of spring sowing is completed, this land ought to be very thoroughly worked and cleaned, its weeds and rubbish freed from all adhering soil, and either burnt in heaps or carried off the field, and its soil reduced to a condition of fine porosity and powder. Both the fact that buckwheat is a cleaning crop, and the fact that its root strikes only about two inches into the soil and yet so spreads its fibres as to fill a circle of five or six inches in diameter, require that the land for growing it should be subject to the most searching preparation, and worked into a state of the highest tilth.

Buckwheat, when intended for seed, is sometimes sown so early as the end of April, and, when intended for ploughing in as manure, so early as the end of May; but it ought never, in this country, to be sown for the former of these objects earlier than the beginning of June, or for the latter, earlier than the beginning of July. When sown before the middle of May, it is liable to be wholly destroyed by frost in one night; when so sown as to bloom before midsummer, its flowers are liable to be extensively blighted; and when intended for green fodder, it ought, in common sense economy, to be sown so late as to come into bloom in a scorching and withering July, when the prime of the grass is gone, the vigour of vegetation is spent, and the pastures are exsiccated and embrowned by heat. The seed should be sown when it may have the advantage of a gentle shower; and it will appear above ground in six or seven days. The quantity of seed proper for an acre is strongly modified by circumstances, and varies from eight to fourteen pecks. If the land have sufficient moisture to induce a rapid vegetation, from eight to ten pecks are enough; but if it be very dry, fourteen pecks, or even a greater quantity, may be required to allow for one proportion which the aridity will prevent from ever vegetating, and for another which will be greedily devoured by pigeons, crows, pheasants, and other birds. "In the year 1795, which was uncommonly dry," says Dr. Hunter, "I sowed four bushels per acre, and had reason to applaud myself for this seeming prodigality." The seed is sown broadcast; and, except for pulling out all large weeds, and afterwards frightening away birds from the ripening seeds, the crop requires no care till the time of ploughing in or harvesting.

Some interesting experiments have been made by agricultural chemists upon the growth of buckwheat, illustrative not only of the economy of its own growth, but of some of the most im-

portant general laws of vegetation. M. Lassaigue placed 15 grains of buckwheat in a platinum capsule, containing some washed flowers of sulphur, which he had moistened with distilled water, recently prepared; he covered the whole with a glass bell; and, by means of a curved glass tube, through a stop-cock in the upper part of the glass bell, he from time to time poured a little water on the sulphur. In the course of two or three days, most of the seeds germinated; and, continuing still to be watered, in the course of 15 days they produced stems about two inches in length, and clothed with numerous leaves. M. Lassaigue now carefully collected the whole of the young plants, and likewise all the seeds which had not germinated, reduced them to ashes in a platinum crucible, and subjected the ashes to analysis. The ashes weighed about $3\frac{1}{4}$ grains; and 220 parts of them contained 5 of silica and 190 of the phosphate of lime. M. Lassaigue next took 15 grains of the same packet of seeds which he had sown, reduced them to ashes, and obtained from them the same results in both weight and analysis as from the young plants and the ungerminated portion of the sown seeds; and he afterwards repeated the whole experiment with precisely the same effect. "It clearly follows," says the report of the experiment, "that, after their development in distilled water, the young plants of buckwheat did not contain a greater quantity of alkaline salts than the seeds from which they were raised; whence we may conclude, with Theodore de Saussure, that the alkalis and earths contained in vegetables have been absorbed and taken in from the soil."—In a series of experiments made by Wiegmann and Polstorff upon vetches, barley, oats, buckwheat, tobacco, and clover, in respectively pure sand and a rich and strong artificial soil, the buckwheat was sown in the pure sand on the 8th of May, and seemed to flourish better than any of the other plants upon pure sand. By the end of May, it had a height of 18 inches, and was considerably branched; on the 28th of June, it began to bloom; till the 4th of September, it continued to bloom without producing seeds; and it certainly would have blossomed still longer, but as it was losing leaves, and was intended for an analysis, it was drawn carefully out of the sand, washed over its roots with distilled water, and dried and reduced to ashes. In the artificial soil, the buckwheat grew very rapidly, and attained the height of $2\frac{1}{2}$ feet; it branched out so strongly as to require the support of a stick; on the 15th of June, it began to blossom; on the 12th of August, the greater proportion of its seeds were ripe; and on the 4th of September, though it was partly in blossom and had a proportion of its seeds unripe, yet on account of its losing too many of its lower leaves, it was pulled up, washed, dried, and incinerated. Twelve grains of the plants grown in pure sand, yielded $\cdot 225$ grain of ashes,—of which $\cdot 086$ was soluble in water, $\cdot 094$ was soluble in

muriatic acid, and $\cdot 045$ was insoluble in either water or muriatic acid; and $12\cdot 7$ grains of the plants grown in the artificial soil, yielded $\cdot 507$ grain of ashes—of which $\cdot 148$ was soluble in water, $\cdot 226$ was soluble in muriatic acid, and $\cdot 133$ was insoluble in either water or muriatic acid.—An analysis of the ashes of buckwheat straw, as conducted by Vauquelin, exhibited 29·5 per cent. of carbonate of potash, 3·8 of sulphate of potash, 17·5 of carbonate of lime, 13·5 of carbonate of magnesia, 16·2 of silica, 10·5 of alumina, and 9 of moisture and loss. The comparatively large proportion of carbonate of potash has suggested the probable remuneration of burning the straw of buckwheat for the obtaining of this valuable salt; but the relative amount of any or all of the saline ingredients to the weight of the crop, as shown by both of the two great experiments which we have narrated, is modified, to a prodigious degree, by the quality of the soil in which the plant is grown.

Buckwheat, when intended for green fodder, ought, as already hinted, to be sown in the first week of June, in order that it may be available at the most parched and needy period of summer. It may also, for a succession, be sown in three crops each a fortnight later than the preceding; and, in this case, it will of course be available throughout a corresponding series of mowings. When cut for fodder, it is most suitable when about half in blossom; and the quantity of it wanted for each day, ought to be mown on the preceding day, at a time when it is perfectly dry; for as cows eat it with the same avidity as clover, and are liable to become blown if they have access to it in a thoroughly green state, it is best adapted for them when it is quite dry and has become a little withered. All domestic animals, particularly cows, weanling calves, pigs, and mares with foal, are exceedingly fond of this fodder, and appear to thrive well upon its use. "The most economical management of it," says Dr. Hunter, "is to put it into moveable racks, because if laid in heaps upon the ground, the cattle will be apt to fight about it, and spoil a great deal by trampling. What falls from the racks, the pigs will take care of. In this manner, the cows will fill themselves in the forenoon with the greatest ease, and ought then to be brought home to the fold-yard, where they will lie down and enjoy rest during the heat of the day; instead of which, if they were in the pastures in search of food, (which at that time of the year is often very scanty,) they would be teased with flies and other insects, be running about and heating themselves, and, instead of increasing their milk, would shrink from it every day more and more. Whoever will make the experiment will certainly be most agreeably surprised by the great quantity of excellent rich milk his cows will produce, at a time when all his neighbours, who have not been so provident, will complain of the considerable reduction of theirs." Yet some distinguished

agriculturists speak cautiously and even disparagingly of buckwheat as green fodder, alleging that it is greedily eaten by cattle and sheep only when they cannot obtain a sufficiency of better food, and that, when eaten in any considerable quantity, it has a stupifying and even intoxicating effect; and Banister says that he has seen hogs, after they had fed heartily on it, thrown into a state of such violent intoxication that they could not walk without reeling. The plant itself, however, is so variable in chemical constitution according to the kind of soil on which it is grown, the stage of growth at which it is cut down, and the state of comparative wetness or dryness, freshness or exsiccancy in which it is used, that the conflicting accounts of it have probably arisen from observations upon it in widely different conditions; and were it always grown upon warm and well-drained land, and cut and used in the manner recommended by Dr. Hunter, it would perhaps, in every instance, prove not only an unobjectionable but a decidedly desirable summer fodder.

When buckwheat is designed to be ploughed in as a green manure, it ought to be sown tolerably thick; and, in consequence of its very rapid method of growth, it will become speedily available, and can be sown with minute calculation of the time at which it shall be ploughed in. When it arrives at the first flush of full bloom, it possesses its maximum of succulency and weight, and is in prime condition for its proposed use; and it ought then to be first laid flat by the roller, and next turned neatly into furrows and completely covered by means of a plough with the addition of a skim coulter. When the ploughing is finished, the seams between the furrows should be closed with a roller; and when more days than one are consumed in the ploughing, the seams of the portion ploughed each day ought to be closed by rolling towards the evening. The land should now remain untouched till the approach of the time for sowing the wheat; and, during the interval, the buckwheat will fully ferment by the action of the sun upon its own juices, and will form a much richer manure than any belonging to a farm-yard dunghill exposed to the play and wash of the rain. But when the soil into which the buckwheat is ploughed has a light and friable texture, it ought to be consolidated by rolling, else the decaying stems of the buckwheat will render it exceedingly loose and hollow; and when it is naturally clayey and tenacious, and requires the very opposite process to consolidation, it receives much benefit, and in particular is mellowed and made porous by the mechanical mixture with it of the buckwheat. In either case, the land was so broken and pulverized by the preceding operations, and is now so freshened with the buckwheat manure, that it requires no further preparation for the sowing of the wheat upon it, than a single harrowing to remove the few light weeds of the

latest growth. Instances are on record of land manured in this manner producing 36 bushels of wheat per acre, though it had formerly produced, in the ordinary way, only 28 bushels. Mr. Ballingal of Trenton, in Scotland, made, in 1826, an experiment in ploughing in buckwheat as manure, which, though not measured in its results, proved quite satisfactory. "The buckwheat," says he, "was sown at the rate of $2\frac{1}{2}$ bushels or little more per Scottish acre, so late as the 21st day of July, and cut down and ploughed in on the 16th of September. But the sowing of the common wheat was protracted, for want of moisture, until the 2d of October. The crop of wheat raised from this vegetable manure was of excellent quality, and equally bulky in straw as the other crops of that grain produced by a sufficiency of farm-yard dung. Not feeling sanguine as to the success of the experiment, I had nearly one half of the buckwheat driven home, and mixed with straw as food for cattle, it being universally predicted that the ensuing winter would be one of scarcity of fodder. It may be mentioned, that the cattle consumed the mixed straw with avidity. The portion of ground left was not measured in this first experiment, and, for this reason, the produce was not exactly ascertained; but the result fully warranted another trial." A second experiment, accordingly, was made by Mr. Ballingal in 1827; and, though still not so accurately marked as could have been wished, brought out results which very powerfully recommend buckwheat manuring to Scottish farmers. The field selected for the experiment had a soil of dry gravelly loam, comprised an area of 18 Scottish acres, and was equally divided between an unmanured summer fallow of buckwheat ploughed green into the soil, and a fallow crop of potatoes both preceded and followed by ample doses of farm-yard dung. The whole cost of the buckwheat fallow up to the time of sowing with winter wheat was £1 4s. 10½d. per acre, and the whole cost of the farm-yard manure upon the potato portion was £5 10s. per acre, a proportion of which, amounting in value to £2, was supposed to be consumed by the potato crop, having a cost of £3 10s. per acre of manurial preparation for wheat, or an excess of £2 5s. 1½d. per acre over that of the buckwheat fallow. Yet the produce of wheat from the buckwheat half of the field was 9½ bolls, while that from the potato half was only 7 bolls, 3 bushels, 2 pecks; and the weight of the former was from 15 stones 10 lbs. to 16 stones per 4 imperial bushels, while the weight of the latter was 15 stones 6 lbs. per 4 imperial bushels. The value of the potato crop obviously ought to be added to the results of the potato-side of the field; yet this, though not stated in Mr. B.'s report, can be pretty proximately calculated by any ordinarily experienced farmer. Let us, however, impress upon persons who have not paid much attention to agricultural chemistry, that green buck-

wheat manuring for a wheat crop can be successful only on the principle of supplying carbonaceous, saccharine, and amylaceous elements, and that whenever a soil does not already contain a sufficiency of alkaline and nitrogenous elements, these must be supplied to it either in the form of farm-yard dung or in that of some similarly constituted manure. See the articles **WHEAT**, **ALKALIES**, **AMMONIA**, **SALTS**, **BONES**, **FARM-YARD-MANURE**, **GUANO**, and **ANIMAL MANURES**.

When buckwheat is raised as a grain crop, it must be harvested at the time of its possessing a maximum of ripe seed. Its succession of blooming and ripening is so long, that the first-formed seeds may not be so full as the next-formed, while either a large proportion of the earliest must be allowed to shed, or a large proportion of the latest cannot possibly come to perfection. A good cultivator, therefore, will carefully examine his crop at different stages of its ripening progress, and determine to reap it only when it appears to possess the largest attainable quantity of ripe and full seeds. Buckwheat may be reaped either by pulling, by sickling, or by mowing. Pulling is preferred by some cultivators on account of its being less likely than the other methods to shake out the ripe seeds; and it is recommended to be performed either early in the morning or very late in the afternoon. But mowing with the cradle scythe is, on the whole, the most economical method; and this lays the crop as regularly down in swathes as if it were laid by hand. The scythe is "put out" in the mowing; and, notwithstanding the singular ease with which the succulent stems are cut, the scythe requires to be swung by a tall and strong man. A good workman will, with apparent ease, mow four or five acres in a day. The crop may either be tied up in sheaves or gathered into small heaps as is often done with pease; but in either case, it must be protected from the depredations of birds, and allowed to remain in the field till it is perfectly dry. The crop, if it retain any considerable degree of moisture, is exceedingly liable to subsequent fermentation in the mass, and to a consequent depreciation in the value of its flour; and hence, in addition to being well dried in the field, it ought to be stacked with intervals of bush faggots, so as to keep up a circulation of air, and to afford vent to any heat which may be generated. Yet Mr. Main of Chelsea says, "If put together a little green or damp, it does not much signify; for though ever so mouldy, the grain is never damaged, and the more mouldy it is, the easier it is thrashed." It ought to be thrashed early in winter; and it is the easiest of all barn-work for the thrasher,—the slightest blow separating the grain from the straw, and no care being required to bind the straw or to assort it. The straw makes excellent litter in the fold, and forms better manure than any other kind of litter. The produce of the grain has sometimes been so great

as seven quarters per acre; but, even in favourable circumstances and upon good land, it probably does not average more than between three and four quarters.

The flowers of buckwheat are rich in honey; and both for that reason, and on account of their long succession, they form a valuable resource for an apiary. The farmers and cottiers of France and Germany greatly appreciate buckwheat crops for their honey, and sometimes carry their bees to them in the same manner as to blooming heathlands.—The straw of buckwheat, gathered before the grain is quite ripe, dried in the sunshine, freed from the grain, moistened in heaps, left to ferment and decompose till it assumes a bluish hue, and then gathered and baked into sun-dried or stove-dried cakes, constitutes a good and convertible blue colouring matter. "On the cakes being boiled in water, the water assumes a strong blue colour, which will not change either in vinegar or sulphuric acid. It may, however, be turned into red with alkali, into a light black with bruised gall-nuts, and into a beautiful green by evaporation. Stuffs dyed blue with this solution, which is to be used in the same way as vegetable matters of a similar species employed in dyeing, become of a beautiful and durable colour."

The grain of buckwheat is a principal ingredient in the distillation of German gin; it is the basis of the beer of the Germans, which is said to be well-flavoured, generous, and wholesome; it is largely used by the distillers of Dantzic in producing the celebrated liquor which the Poles call goldenwasser, and the French eau de vie de Dantzic; it is bought up from British farmers, and imported in vast quantities from Holland, and other countries of northern Europe, by the gin-distillers of England for the manufacture of their 'blue ruin;' and it has been malted and used in the brewing of British beer, but is found to produce a liquor which, though palatable, is unwholesome and dangerously intoxicating. A writer in the Magazine of Domestic Economy remarks, "The use of barley malt has been resorted to in preference to any other, because barley is supposed to contain a greater proportion of saccharine or fermenting matter than almost every other grain besides wheat, or, at all events, than any other grain of a similar quality and price. Now, buckwheat is most fruitful in the saccharine principle, even much more so than barley, than which also it can be raised at considerably less expense. It is therefore certainly worth the while of both the maltster and the distiller to give buckwheat a fair trial, should it ever be sufficiently cultivated in this country to afford them an opportunity of doing so; and there is no doubt that it will be so cultivated when actual experiment shall have given evidence of its eminent usefulness."

The flour of buckwheat is white and fine, and serves well for cakes, pastry, and various other

forms of edible preparation, though, in consequence of a deficiency in gluten, it is not sufficiently cohesive for making fermented bread. It contains less starch than wheat-flour, and is scarcely so white in colour; yet it makes as good and as nourishing bread, it is not so liable to acidification on a weak or dyspeptic stomach, and it possesses a delicacy and a fragrance of flavour which are grateful to both children and adults, and which render it peculiarly suitable for cakes and tarts and the various articles of pastry. It is used for making crumpets in Italy, in Holland, and in other parts of Europe; and the crumpets of it, when eaten with butter, are a favourite dainty of children. It is employed with either water or milk for making hasty puddings, which are eaten with butter or sugar. It is very commonly mixed with the flour of rye or of wheat, in most parts of the continent, by both public and private bakers. In Saxony, in Brandenburg, and in Silesia, buckwheat forms part or whole of all the three daily meals of the lower class, and of at least two of the daily meals of even the wealthiest classes. The dish of boiled buckwheat is of the same consequence to the German peasantry of these regions, as the meal of boiled potatoes to the peasantry of Ireland; and various preparations of buckwheat figure more prominently on the tables of the opulent and the highborn, and constitute a more important article of their diet, than potatoes among the middle classes of Great Britain. Millions of the German peasants not only thrive upon it, so as to be as healthy, handsome, and vigorous a race as any in Europe, but are not at all fastidious as to the niceties of either its grinding or its cookery. "The grain in its unsophisticated state, after it has been thrashed and winnowed, is coarsely broken in a common handmill, which is generally a flat buhr-stone running on a pivot within another, with a hole to admit the grain, and having, near the edge, an upright iron handle which serves to turn it. The grain being broken, is boiled with the husks on, in water containing a little salt, until the porridge is of a very substantial thickness. The mess is then served up with a lump of butter in it. Some, as a luxury, mix milk with it after it is boiled. The more wealthy have the grain prepared by the miller, so as to free it from the husks, much in the same manner as pearl barley in Scotland; but many true Silesians of the upper classes, from youthful associations and tastes, like Kean's love of a baked shoulder of mutton with potatoes under it, or from that *amor patriæ* which makes even a blemish look beautiful, or from some other cause which we leave to the sagacious to discover, prefer the look and taste of the unseemly brown husk, from the same cause perhaps that makes the genuine Scotchman delight in the flavour of burnt wool with which his barley broth is so deliciously impregnated when made of a singed sheep's head. Whether husked or not, however,

a dish of buckwheat, in its boiled form, makes its appearance at every Silesian gentleman's table, and is always welcome to each member of the family." For infants, as well as for more advanced children, dressed buckwheat flour is a wholesome, nourishing, and very digestible food, promoting regularity and healthiness of the secretions, keeping the intestinal system in an unobstructed condition, and imparting strength and activity to the frame. It is far preferable to oatmeal for the making of gruel, quite as cheap, if not cheaper, and constituting superior nourishment and a more substantial meal; and it might, with advantage, supersede oatmeal wholly in the workhouses of the poor-law unions of England, and partially in the cottages, farm-houses, and towns of Scotland. Its great disadvantages are its want of sufficient gluten for making good fermented bread, and its considerable inferiority to wheat flour in the properties of farina; but the former of these is compensated by its eminent adaptation to every kind of pastry, pudding, and dry bread, and the latter is compensated by its comparatively great cheapness,—for a bushel and a half of buckwheat will go as far in producing human food as a bushel of wheat, and, being more than two-thirds lower in market value, it would cost its consumer in bread only about half the price.

The grain of buckwheat ought never to be given to horses, for it heats them, and fills them with bad humours; and, in general, it has so decidedly different a shade of properties in a raw state from those which it possesses in a cooked state, that it seems to be deprived of some deleteriousness by the process of cooking. Yet it is an excellent means of quickly and very economically fattening pigs, turkeys, and all kinds of poultry. When given to pigs, it ought to be broken in a mill to prevent its passing undigested [see the article BRUISING-CORN]; and it ought also to be given at first in very small quantities, mixed with oats or some other kind of corn, and afterwards slowly increased in quantity till it becomes the chief food. Some persons recommend, indeed, that it never be given in larger proportion than one-third of the whole mixture of grains; and all agree that if incautiously given in large or even moderate doses at the first, it will violently stimulate the pigs, making them tumble, squeak, rise against walls, roll in the mud, and otherwise behave as if excessively intoxicated. When these symptoms are produced through incautious commencement of the buckwheat, they will disappear in the course of three or four days; yet they incur some risk of being followed by the animals' loss of condition. But when buckwheat is properly used, it fattens hogs in less time than any other known food, and occasions their flesh to be peculiarly succulent and delicate; yet, during the last eight or ten days, it requires to be accompanied with ground pease in the proportion of two to one, in

order to give proper firmness to the fat.—The grain of buckwheat is likewise admirable for fattening poultry and pigeons; yet, in this case also it ought, during the last few days, to be accompanied or even substituted by barley. Fowls and turkeys, when fattened with buckwheat, have an eminently delicious flavour; and the poultry, particularly the turkeys, of Norfolk, very probably owe to their feeding upon it all the excellence which occasions them to be preferred in the markets of London to those of every other part of England. Pheasants are so fond of buckwheat that they travel miles in search of it; and, if one or two waggon-loads of it, unthrashed, be laid in small heaps in different parts of the covers of a preserve, all the pheasants of the immediately circumjacent district will be attracted thither as their resort.—*Lawson's Agriculturist's Manual*.—*Bulletin des Sciences Agricoles*.—*Rennie's Field Naturalist's Magazine*.—*Literary Gazette*.—*Magazine of Domestic Economy*.—*Quarterly Journal of Agriculture*.—*Loudon's Hortus Britannicus*.—*Hunter's Geographical Essays*.—*Young's Farmer's Calendar*.—*Liebig's Chemistry of Agriculture*.—*Catalogue of the Highland Society's Museum*.—*Low's Elements of Practical Agriculture*.—*British Husbandry*.—*Doyle's Practical Husbandry*.—*Loudon's Gardener's Magazine*.—*Rham's Dictionary of the Farm*.—*Mill's Husbandry*.—*Duhamel's Elements of Agriculture*.

BUCKWHEAT-TREE,—botanically *Mylocaryum ligustrinum*. An ornamental evergreen shrub, forming a genus of itself, in the heath-flowering family. It is called in the Botanical Magazine, *Cliftonia ligustrina*. It is a native of Georgia, requires a little protection in winter, grows to the height of about nine feet, has privet-like leaves, and four-winged seeds, and produces white flowers in May and June.

BUD. A bud is that part which "contains the rudiments of a plant, or of part of a plant, for a while in a latent state, till the time of the year, and other circumstances, favour their evolution." From buds, then, an entire plant may be produced, if placed in favourable circumstances, or only a branch, or leaves, or flowers. We can, however, reckon no more than two kinds, those that produce leaves, and those that produce flowers. There is the closest analogy between these organs and bulbs; so close, indeed, that Mirbel, and some others, arrange them together. Practical cultivators mark distinct characters peculiar to each kind of bud. Those that produce leaves are small, long, and pointed; the flower buds, again, are thick, short, and round. It appears probable that some unknown agents influence the formation either of flower-buds or of leaf-buds, or rather that some circumstances will cause the evolution of either of them from the same bud. A fact recorded in the Linnæan Transactions in some measure favours this opinion. The *Solandra grandiflora*, a native of Jamaica, had been long cultivated in

the English stoves, and propagated by means of cuttings; but none of the plants ever displayed any signs of fructification. They had been always well supplied with water. One plant, by accident, was left without being watered in the dry stove at Kew: the consequence was, that the branches were much stunted in their growth, and flowers were produced. The experiment has been frequently repeated with success. It appears that whatever checks the luxuriance of the leaves, tends to the formation of flowers and seeds.

For the purpose of converting leaf-buds into flower-buds, various expedients may be used with advantage; such as scoring the bark to the wood very deeply with a knife, twisting a wire tightly round the stem, or by cutting off a cylinder of the bark, and replacing it with a bandage. It is said that there is an intermediate species of bud, which retains some of the characters of each. A striking difference has been noted between the leaf and the flower-buds; the first may be removed with impunity from its original situation, and placed in the earth, where it will vegetate with luxuriance; but the last uniformly dies. Both may be removed to another stock with success. This operation is called *budding* or *inoculation*, and is well known to gardeners. See next article.

The usual position of buds is in the axillæ of the leaves, except in the genera *mimosa*, *gleditsia*, and a few others. The buds are opposite to each other when the branches or leaves are opposite, alternate when the latter are alternate, and terminal when the leaves are terminal. In those plants that have both opposite and alternate leaves or branches, the buds are commonly solitary.

Various forms are assumed by different buds, according to those of the contained leaves; an admirable adaptation of convenience to beauty and regularity being always preserved. Nature has given different coverings to different vegetable productions, according to the peculiarities of their respective climates. In northern regions, the buds are almost uniformly clothed with scales, or with a downy substance; sometimes these are conjoined, besides being coated with a resinous matter. The horse-chestnut is a good illustration of large well-formed buds. By means of these coverings, the young bud is enabled to brave the vicissitudes of the seasons, and to be ready to burst forth on the first approach of spring. This singular power of retaining its vitality, has been considered by some physiologists as the distinctive character of true buds. The most external of the scales are dry and hard, while those which are more protected from the influence of the weather, are soft and succulent. The protection afforded to the bud, by the resinous covering which occasionally envelopes it, is well shown by a very simple experiment. Take a bud, for instance, of the horse-chestnut, and

close the part which has been just separated from the stock with wax, plunge it into water, and it will remain there without undergoing any alteration for a number of years. In mild, or even warm countries, buds have no scales, as they do not require them. Those trees that form an exception to this observation, can thrive indifferently in any climate; so that the rule holds in all distinct cases. The scales are considered by many as imperfect leaves.

The internal structure of buds is said not to differ, in any respect, from that of the plumule, previous to its being detached from the seed. Some have fancied that they have seen the rudiments of every part of the tree concealed in the bud; and Mr. Ferber expresses high delight at having observed in the buds of the *Hepatica* and *Pedicularis vulgaris*, yet lying in the ground, the perfect plant of the future year. We are much inclined to question the accuracy of such very minute observers, and, of course, are more willing to impute any errors to optical deception than any wish to mislead.

The bark and the pith have been generally considered the source of the buds; but the ingenious experiments of Mr. Knight have set aside both of these hypotheses, and have established, as far as the present state of the science will permit, the doctrine, that they derive their origin from the alburnous portion of the tree. This gentleman first showed, that they do not originate in the pith or bark; and also, that Duhamel's opinion of pre-existing germs being their source, is at least improbable. He then proves, that the "alburnous vessels at their termination upwards, invariably join the central vessels; and that these vessels, which appear to derive their origin from the alburnous tubes, convey nutriment, and probably give existence to new buds and leaves. It is also evident, from the facility with which the rising sap is transferred from one side of a wounded tree to the other, that the alburnous tubes possess lateral, as well as terminal orifices: and it does not appear improbable, that the lateral as well as the terminal orifices of the alburnous tubes, may possess the power to generate central vessels, which vessels evidently feed, if they do not give existence to the reproduced buds and leaves. And therefore, as the preceding experiments appear to prove, that the buds neither spring from the medulla nor the bark, I am much inclined to believe that they are generated by central vessels, which spring from the lateral orifices of the alburnous tubes." By interrupting the circulation in the alburnum, buds may be artificially produced; and nature has provided means for their reproduction, in those cases where they may have been accidentally destroyed. Several curious facts on this subject may be obtained by an examination of the potato, which, like other tuberous roots, are studded with them.

Buds of all kinds are formed about midsum-

mer; after which it has been stated, "that there seems to be a kind of pause in vegetation for about a fortnight." Darwin imagined that a store of nourishing matter is collected during that period, which produces the apparent pause. The season of development is most usually that of the spring, when nature seems to delight in new products: it is then that the buds are evolved, and enter upon the important functions they are destined to perform. Nothing, however, is known of these functions beyond the general result. Branches, leaves, and flowers are produced by buds; but what are the particular operations by which these effects are induced? The answer is easy, but unsatisfactory. Buds transpire, and in all likelihood produce the same chemical changes on the atmosphere with the other parts of the plant.

BUDDING. The propagating of ligneous plants or parts of ligneous plants by grafting buds or eyes of one plant upon the stocks of another plant. While every method of ordinary or true grafting consists in inducing a ligneous portion of a stem or branch to incorporate itself with another stem, the art of budding consists in detaching a bud from all ligneous matter, rendering it strictly an embryo in connexion with a little cortical matter, and so inserting its connected cortical matter through an incision in the bark of another plant, that an organic union may be formed with its wood. Some of the best known and most striking examples of budding are our rose-trees and our finely-shaped standard fruit-trees, the former produced by budding low and scrambling rose-bushes with elegant flowers upon the tall, strong stems of wild rose-trees, and the latter by budding low and ill-shaped plants with the richest varieties of fruit upon the strong and well-formed stems of coarse or wild fruit-trees. But though all buddings are closely similar to these examples in their principle, and though all, like the several kinds of grafting, are successful only with very nearly related plants, yet they are considerably various in both object and method.

Escutcheon budding without an eye, is designed simply to cover a wound or blemish in one tree with a piece of the live bark of another. The operator takes from a tree of the same genus or species as the wounded tree a piece of bark rather larger than the wound, forms it into a regular shape, cuts a vacancy in the bark round the wound of exactly the size and shape of the piece, fits the piece into the vacancy, fastens it on with a ligature, and closes the edges with grafting wax or clay. The wood formed immediately below the piece is of the species of tree from which the piece was taken; and, in consequence, by means of mere escutcheon budding without an eye, patches of several kinds of wood might be formed upon one tree.

Budding with an eye and a circular escutcheon is practised to equalize the distribution of flower-

buds over a plant, by removing some from parts where they are crowded to parts where they are few and distant. The operator, with the point of a penknife, cuts out a small bud, leaves a narrow rim of bark around it, and a small attached portion of wood; he makes a vacancy in the bark, at the place to be budded upon, of the same size and shape as the bud and its rim, and cuts in the wood a hole of the same depth as the small piece of wood attached to the bud; and he then adjusts the wood and its accompaniments exactly into the cavity and hole, fastens it on with a ligature, and covers its edges with grafting-wax.

Escutcheon budding with wood under the bark, is the method most generally practised in European nurseries, and serves the purposes of propagation in nearly the same manner as grafting. The operator, with a grafting knife, makes a deep and transverse incision above a healthy and vigorous bud; he withdraws the knife, and so reapplies it as to bring away a strip of bark, three or four lines broad, an inch or an inch and a half long, terminating in a point at the bottom, and having the eye of the bud situated about third way from the top; he cautiously removes the stipules, prickles, or appendages of any other kind which may happen to accompany the petiole; he, with the point of the grafting-knife, takes away so much of the adhering wood of the bud or escutcheon as to leave only a small piece immediately under the eye; he next makes an incision in the bark of the stem to be budded, and, by means of an ivory blade, separates, to the requisite distance, the adjoining part of the bark from the wood; he inserts in this the prepared bud or escutcheon, and gently pushes it downward into exact adjustment beneath the separated bark; and, as in the preceding methods, he finishes by fixing with a ligature, and covering with grafting-wax.

Escutcheon budding with a growing bud, is performed in the same manner, and with the same specific object as the preceding method, except that the bud selected is in a pushing or developing condition, that, as soon as the escutcheon is inserted, the head of the stock is cut off, and that, afterwards, all buds upon the stem, additional to that of the escutcheon, are rubbed off the instant they appear. This method, when practised in the spring, forces the bud into immediate development, and in consequence saves a year in the growth of its shoot. Yet if it be not dexterously and very nicely performed, so as to effect an almost instant organic union between the tissues of the escutcheon and those of the stem, the sap of the plant, having no outlet by either the bud of the escutcheon or its own proper buds, accumulates in the interior tissues, gorges them to repletion, and chokes them to death. When this method is practised later than July, the young shoot of the escutcheon is almost always killed with the frosts of winter, and, in very many instances occasions the death of the stock.

Escutcheon budding with a dormant bud, is the method generally practised in the nurseries of Great Britain. It is the same in manipulation, or art of execution, as the preceding method; but it is performed in August, an escutcheon with the most embryo kind of bud is used, and, in order to prevent the development of the bud till next year, nothing is cut away from the stock till the following spring. Though longer in taking effect than the preceding, it is more certain of success; and when it fails, it does not injure the stock.

Escutcheon budding without the wood, is quite the same in both process and object as the preceding methods, except that no more of the attached wood of the escutcheon is suffered to remain than a mere speck immediately beneath the eye. The adhering wood is removed by holding the escutcheon firmly between the finger and the thumb of the left hand, and applying the knife with a jerk of the right hand. This method can be practised with either the growing bud or the dormant bud; and it is peculiarly suitable for orange-trees, and for all shrubs and trees with hard timber, such as hollies, myrtles, and all analogous species, whether indigenous or exotic.

Escutcheon budding with pincers, is practised with old trees, whose thick, rugged, and broken bark is not manageable by the ordinary methods. The operator, with a pair of pincers made for the purpose, or with the blade of a grafting-knife, takes off a plate of bark, having a vigorous shoot in its centre; he pares its edges into a smooth outline and precise shape; he, with the pincers, removes from the stock to be budded upon a plate of bark slightly less than that of the escutcheon, and pares the consequent cavity into exact shape and adaptation for the reception of the escutcheon; and he then adjusts, fastens, and cements in the same manner as in the other methods.

Escutcheon budding with the eye turned downward, is practised upon fruit-trees with the design of so accumulating or stagnating their sap as to occasion an enlargement of their fruit. The escutcheon is so cut and adjusted, that, whether the incision in the stock be made in the usual manner or like an inverted J, the point of the eye is turned downward. The shoot, in consequence, commences its growth in the opposite to the natural direction; but it soon assumes its proper position, and renders the design of this peculiar method of budding altogether nugatory.

Reversed escutcheon grafting, is the principal method practised in the south of Europe for multiplying orange-trees, and is suitable for the propagation of all trees which abound in gummy sap. The escutcheon is cut in the form of an acute triangle, with the apex or point above the bud; the incision in the stock is made in the form of an inverted J, or with the transverse cut below and the longitudinal one above; and the fixation of the escutcheon, as in other methods,

is effected by ligature and wax. Yet under the coolness and moisture of the ordinary climate of Great Britain, the wax may be dispensed with in both this method and the three or four preceding ones.

The budding of resinous trees, is adapted to trees which have resinous juices or which abound in gummy sap. An incision in the form of a T, as if for an ordinary bud, is made in the bark of the stock; a double incision is then made obliquely, and to the depth of nearly a line, about two lines or two lines and a half from the upper part of the T, and the escutcheon is prepared and adjusted in the ordinary methods.

Covered budding is an intricate and complicated method characterized by extreme precaution against failure, and adapted to the case of rare and delicate trees. The escutcheon is prepared and inserted in the usual manner; it is cautiously and gently fixed with merely a covering of grafting-wax round its lines of junction, and without the use of any ligature; a piece of bark from another tree is pierced with a hole through its centre, and so adjusted over the escutcheon as to cover the whole of it except the bud, and to let the latter peer through the hole; and ligatures are tied over the bark, above and below the bud, to hold all firm.

Budding with a square escutcheon was, at one time, commonly and successfully practised; but it is a tedious method, and has passed generally into disuse. A transverse incision, four or five lines in length, is made in the stock; two longitudinal incisions, parallel to each other, and four or five lines in length, are made downward from the ends of the transverse one; and the square of intermediate bark is raised and folded down. A square escutcheon, with a good bud in its centre, is provided, and fitted precisely into the bared part of the stock; the plate of bark, which was hanging down, is so raised over the escutcheon as to cover it up to the eye; and the grafting-wax and ligature are applied as in other methods.

Escutcheon budding with a portion of terminal buds, is peculiarly adapted to such rare trees as have scaly buds and opposite branches. A piece, six or eight lines in length, of the top of a terminally budding branch, is so split in two as to divide the terminal bud exactly through the middle; and an incision in the form of a T is made in the stock, and the half-bud inserted and adjusted in the usual manner. The growing bud is always far preferable to the dormant one for this method; and, when great economy of the means of propagation is desirable, the terminal bud may be split into four, so as to make four buddings.

Annular flute budding is peculiarly suitable for the propagation of walnut trees, and of all rare trees with hard wood, such as the American oaks and chestnuts. A ring of bark with a bud on it is made on a branch of the tree to be pro-

pagated exactly as thick as the intended stock, and this ring is detached by being once split or cut perpendicularly, and then raised all round with the spatula-like handle of the budding-knife. A ring of bark of precisely the same breadth, either with or without a bud, is detached from the stock. The ring from the branch is precisely adjusted to the vacant belt round the stock, and made tight with grafting-wax or grafting-clay; and neither the head nor the branches of the stock are cut away till the budding belt has become united to the wood. This method is most suitably practised either at the time of the greatest movement of the sap in spring, or at the end of the greatest movement in August. One great recommendation of it is, that it never mutilates the stock; for where the budding belt fails, the natural growth of the stock's bark heals the whole of the wound, and forms a new cortical surface. A slight modification of it, called split flute budding, is most frequently necessary; but this differs from annular flute budding only in the budding-ring of bark being taken from a branch somewhat thicker than the graft-stock, and in a longitudinal stripe being cut from it to make it exactly fit.

Tube budding, or flute budding by close contact, is principally practised in the south of France for propagating walnuts, chestnuts, figs, mulberries, and other trees which have a thick bark and an abundant pith. The head of the stock is cut off, and a tube or unsplit belt of bark, two or three inches in breadth, is removed. A shoot or branch of the tree to be propagated is cut through at a part of precisely the same thickness as the cut part of the stock, and having immediately below it two or three good buds; a tube, containing these buds, and not so broad as the tube from the stock, is removed from the branch; this tube is placed upon the stock in the room of the one taken away, and is made to fit exactly, all round, to the edge of the remaining bark; and the part of the stock which projects over it is split into shreds, folded over the bud-tube, and made fast in that position with a covering of grafting-clay.

Common flute budding is very generally practised both in France and in Germany. The head of the stock is cut off, as in the preceding method; but the portion of bark which, in that method, would be removed in the form of a tube, is, in this method, cut downward into four or five longitudinal stripes, which are turned down, and left attached to the tree. A tube with buds is provided and adjusted exactly as in the preceding method, except that it is so broad as to fit nearly up to the top of the decorticated part of the stock. The stripes of bark which were turned down on the stock are raised over the bud-tube, and fastened with a ligature at the top.—Another method, called flute budding in shreds, with the stock cut obliquely, is closely similar to the two preceding methods.

BUDDLEA. A genus of ornamental shrubs, of the figwort tribe. The species longest known in Britain grows indigenously in Jamaica and most of the American islands. Its stem rises to the height of ten or twelve feet, and is thick, woody, and covered with a grey bark; its branches deflect from the upper part of the stem, are numerous, and come out in opposites; its leaves also come out in opposites, and are oval, serrated, and covered on their under surface with a brown hairy down; and its flowers have a yellow colour, and are produced at the ends of the branches in long close spikes, branching out into clusters. One deciduous and hardy species, about 15 feet in height, and producing orange-coloured flowers in May and June, was brought, in the latter part of last century, from Chili; and nine tender evergreen species have been introduced, principally during the last twenty-five years, from Nepaul, Java, Madagascar, the Cape of Good Hope, Brazil, and Mexico.

BUFFALO,—scientifically *Bos Bubalus*. A quadruped of the ox tribe. It has, for a long period, been domesticated in India; and it has been diffused thence into various countries of Asia and Africa, and into Greece, Italy, and Spain. It is at once a heavier, a clumsier, and a stronger animal than the *Bos Taurus* or common European ox. Its limbs are short, thick, and massive; its body is bulkier than that of our bull; its hide is coarse, thick, and clothed with black wiry hair; its head is large, its forehead convex, and its muzzle projecting; its ears are large and pendulous; its eyes are sparkling and fierce; its horns are long, compressed, and turned so far back as to be unfit for forward goring; and its tail is slender and long. It is so bold in temper as not to be easily tamed or managed; and yet is so athletic and enduring as, in some countries, to be of great domestic value. It often fights and sometimes vanquishes the tiger in India; it exists in both a wild and a domesticated state in many parts of continental Asia, in some of the East India Islands, and in the Calabrian highlands and pestiferous marshes of southern Italy; it acts a valuable part in the splashy agricultural labours of China, and in the wet and dreary rice cultivation of the Ghauts; it forms herds of high price in hot pestiferous marshes, and in some other repulsive situations where no other description of agricultural stock can exist; and it acts as an invaluable beast of burden and of draught in trackless districts of Asia, in wild wastes of Africa, and in marshy plains of Calabria which, but for its aid, would be impervious to traffic and almost untraversable by man. Its flesh is hard and unsavoury, and yet is much relished in many parts of the East; and the milk of the female is singularly rich, and yields a considerable proportion of butter.

"The common buffalo," remarks Professor Low, "was early known in Egypt and Greece. He was introduced, it is supposed, about the seventh

century into Italy, and is now an important animal in the rural economy of that country. He is used by the Italians as food, and as the beast of labour, and may be said to form the riches of the inhabitants in many parts of the country. He prefers moisture and the rank herbage of marshes. The milk of the female is good; but the flesh is held in less esteem than that of the common ox. The pace of the animal is slow; but from the low manner in which he carries his head, throwing the weight of his great body forward when pulling, he is well suited for heavy draught. But this is not a property sufficiently important to cause the introduction of the buffalo into the agriculture of Northern Europe; and he is not likely, therefore, to be carried beyond the countries where he is now reared." A breed of buffalo cattle was introduced, about twenty-five years ago, to the Duke of Northumberland's beautiful park at Alnwick; and, though the bull died soon after his arrival, a fine cross with the Highland kyloe, strongly characterized with the peculiarities of the buffalo race, continues to be preserved. The flock is usually kept up to the number of about thirty individuals; and is not permitted to have, at any one time, more than one or two bulls. "They have promiscuously bred among each other, care being taken to preserve those for breeders which most resembled the originals, the size of the characteristic hump on the shoulder being the principal guide. They are treated in a great measure like the other cattle, only, from their wild nature, no attempt has been made to handle them. During severe weather, or a storm in winter, they have a hovel to run into; and although they do not seem to bear the cold climate so well as one of their progenitors, the kyloes, they are usually very healthy. When the calves are dropped, the mother endeavours to secrete them among the long grass for a few days, like other wild cattle, so that the herdsman has to watch the place, and a favourable opportunity, to castrate or spay them. They are good graziers; the young ones getting into excellent condition in the summer; and although they evidently lose flesh in the winter, yet by the time they are killed in the fall of the year, when four or five years old, they are very good beef. The meat is finely marbled, and well-flavoured."

The Cape buffalo, *Bos caffer*, has sometimes been mistaken for the common buffalo, but is very different both in appearance and in disposition. It has never been domesticated nor tamed to labour. Its horns are very remarkable, not for their extraordinary length, but for their roots and base, rugged and uneven, being so unusually broad as to cover the whole forehead, and to impart to it, says Burchell, the appearance of a mass of rock. The expression of the animal is savage and malevolent. Its bulk exceeds that of the ox; for though its height is not much greater, it is more robust and strongly built. Its

muzzle, when young, is but thinly covered with hair, the withers are high, the tail short. This buffalo is found in abundance, or rather, used to be found, in Southern Africa, and thence stretches into the interior along the east coast as far as has hitherto been explored; and this is its only known locality. All travellers are agreed it is dangerous to intrude incautiously into the haunts of the buffalo, as it is easily irritated, and rushes with blind fury against the object of offence, bearing all before it. In its native regions it is killed in pitfalls, like many of the larger game, by the natives, but the European makes use of the rifle alone. The following account of a buffalo-hunt is very characteristic of the animal. A party of boors had gone out to hunt a herd of buffaloes, which were grazing on a piece of marshy ground. As they could not conveniently get within shot of the game without crossing a part of the marsh, which did not afford a safe passage for horses, they agreed to leave their steeds in charge of their Hottentots, and to advance on foot, thinking that if any of the buffaloes should turn upon them, it would be easy to escape by retreating across the quagmire, which, though passable for man, would not support the weight of a heavy quadruped. They advanced accordingly, and under covert of the bushes, approached the game with such advantage, that the first volley brought down three of the fattest of the herd, and so severely wounded the great Bull leader, that he dropped on his knees, bellowing furiously. Thinking him mortally wounded, the foremost of the huntsmen issued from the covert, and began reloading his musket as he advanced to give him a finishing shot; but no sooner did the infuriated animal see his foe in front of him, than he sprang up and rushed headlong upon him. The man throwing down his heavy gun, fled towards the quagmire; but the beast was so close upon him, that he despaired of escaping in that direction, and turning suddenly round a clump of copse-wood, began to climb an old mimosa tree which stood at the one side of it. The raging beast, however, was too quick for him, bounding forward with a roar, which my informant described as being one of the most frightful sounds he ever heard, he caught the unfortunate man with his horns, just as he had nearly escaped his reach, and tossed him into the air with such force, that the body fell dreadfully mangled into a cleft of the tree. The buffalo ran round the tree once or twice, apparently looking for the man, until weakened with the loss of blood, he again sunk on his knees. The rest of the party recovering from their confusion, then came up and despatched it, though too late to save their comrade, whose body was hanging in the tree quite dead.

BUFFONIA. A small genus of herbaceous plants, of the carnation tribe. The annual or slender-leaved species, *Buffonia annua* or *Buffonia tenuifolia*, is a rare and curious annual weed of the sea-coasts of England. Its root is slender and

fibrous; its stem is smooth, round, and about six inches high; its leaves are awl-shaped and three-ribbed; and its flowers are white, solitary, erect, and small, and appear in June.—The perennial species, *Buffonia perennis*, was introduced about thirty years ago from France. It is perennial-rooted, and carries a white flower in June and July. Two other species have been scientifically described. The genus is named after the celebrated naturalist Buffon.

BUG (BLIGHT). See **APHIS**.

BUGLE,—botanically *Ajuga*. A genus of ornamental herbaceous plants, of the labiate family. The common creeping species, *Ajuga reptans*, grows wild in moist situations, particularly in moist woods and coppices, in Britain. An old account of it succinctly describes it, as "a low weed with two kinds of stalks; round creeping ones, which strike root at the joints; and upright square ones, hairy on two of the opposite sides, alternately from joint to joint bearing loose spikes of blue labiated flowers, of which the upper lip is wanting; the leaves are somewhat oval, soft, slightly cut about the edges, and set in pairs at the joints." The flowers are scentless, and bloom in May and June. The plant is hairier in mountainous situations than in valleys. Two varieties of it, the white-flowered and the red-flowered, *A. r. alba* and *A. r. rubra*, are recognised in systematic botany; and the former of these abounds in the Isle of Wight. This plant has a high medicinal reputation among the peasantry of France; yet, except some little astringency in its roots, it possesses no property which can apologize for that reputation. Its old names among the British peasantry are sicklewort, middle-compound, and herb-carpenter.—The alpine species, *Ajuga alpina*, grows wild on the mountains of England, and is a beautiful perennial, of similar height, habits, and colour of flower to the common creeping species.—The pyramidal species, *Ajuga pyramidalis*, grows wild on the mountains of Scotland, has only about half the height of the two preceding species, and produces a purple flower in May and June.—The ground pine species, *Ajuga chamæpitys*, is an annual weed of the sandy fields of England, and bears yellow flowers from April till July.—The first, the second, and the third of these native species, and also the oriental and the Genevese, long ago introduced from respectively the Levant and Switzerland, are somewhat commonly cultivated as ornamental flowering plants in British gardens. Five other hardy exotic species are sometimes met with in Britain; and six or seven additional but un-introduced species have been botanically described.

BUGLOSS. See **ALKANET**.

BUGLOSS (VIPER'S),—botanically *Echium*. A large genus of ornamental and extensively diffused plants of the borage family. One species is a native of Great Britain; about sixty species have been introduced from foreign countries; and about twenty other species are known to botan-

ists. About a dozen of the introduced species are hardy annuals; eight or nine are hardy biennials; two are greenhouse evergreen herbs; and the rest are greenhouse evergreen shrubs. Many of the greenhouse species are eminently beautiful; but only two, *E. grandiflorum* and *E. longifolium*, seem to be very generally known. Some of the annual and the biennial species, though pretty enough in the flower, have a coarse, bulky, untameable appearance in the plant; and yet the two annuals, *E. violaceum* and *E. orientale*, and the two biennials, *E. cretioum* and *E. italicum*, obtain considerable favour.

The common species, *Echium vulgare*, is a biennial, and grows wild in rubbish and old walls, in gravelly and stony fields, and particularly in dry waste grounds, in many parts of Great Britain. It is all profusely covered with prickly bristles and intermixed stiff hairs. The stems are two feet long, and either erect or spreading; the leaves are alternate, lance-shaped, dull green, single-ribbed, and tapering at the base; and the flowers grow in numerous crowded clusters, are pink in the bud and blue or purple in full development, have a very showy appearance, and bloom in July and August. A white-flowering variety is systematically recognised under the name of *E. v. flore albo*. An account of this species, written about a century ago, says, "Bees are very fond of the viper's bugloss; and there is reason to think that this plant, assisted by the culture of a skilful gardener, may receive, perhaps, as many improvements as the auricula did. Its branches will rise to the height of three feet; and no vegetable would better adorn flower-pots in large chimnies; for if the water be changed, it continues blowing near a fortnight after cutting. Its ultramarine blue colour, is the finest that can be seen; and the stalks are garnished with flowers from top to bottom. Dyers might, perhaps, extract an useful tincture from the roots."

BUGLOSS (WILD),—botanically *Lycopsis*. A genus of plants of the borage tribe. The botanical name *Lycopsis* signifies "the face of a wolf," and alludes to the form of the flowers. The common or corn-field species, *Lycopsis arvensis*, called by Decandolle *Nonea arvensis*, is a handsome annual, and grows wild in the corn fields, dry banks, and waste grounds of Great Britain. Its root is small, tapering, and whitish; its stems are rough, round, erect, solid, bristly, black-spotted, and about 15 inches in height; its leaves are bristly and light green; and its flowers are bright blue, and bloom from May till August. It is sometimes called ox-tongue, and is occasionally used like borage in cool tankards; and it was formerly employed in decoction as a medicinal drink for nurses. Five species, all hardy annuals, but of no particular interest, have been introduced from Teneriffe, the Levant, Caucasus, and the south of Europe; and eight or nine other species are known.

BUGWORT,—botanically *Cimicifuga*. A genus of perennial-rooted herbaceous plants, of the ranunculus tribe. The fetid species, *Cimicifuga fetida*, formerly called *Actæa cimicifuga*, is a medicinal plant, and forms the type of the genus. It takes its name of cimicifuga from two words which indicate its supposed principal quality, and signify "to drive away bugs." It is a native of Siberia, grows to the height of about four feet, and produces a light yellow flower in June and July.—Three species have, somewhat recently, been introduced from North America; and one of these, *Cimicifuga americana*, called by Decandolle *Actæa podocarpa*, is cultivated as an ornamental plant.

BUILDINGS. See FARM-BUILDINGS.

BUISTING. See BRANDING.

BULB. A roundish vegetable body, usually in the form of a depressed and round-based cone, intermediate in constitution between a seed and a root, and sustaining the several characters or serving the various purposes of an epitome of a plant, a hybernaculum or winter-case around the embryo of a plant, a storage of nourishment for the early and even entire growth of a plant, and an organic contrivance for a plant's propagation in the peculiar manner of offsets or young bulbs. A bulb is very generally but quite erroneously regarded as a root. The bulbs of a few species are produced on the stems, and therefore do not even occupy the position of roots; and the great majority of bulbs, though naturally immersed in the soil or in water, produce roots from below and stems from above in a manner closely analogous to the radicle and the plumule growths of seeds. A fleshy disk, or knob, or tubercle, or annular projection may be observed at the base of every bulb; and this constitutes both the cradle and the attachment of the true roots; and, when placed in contact with soil or water, according to the nature of the plant, it sends down the roots, sometimes in the form of multitudinous filiform fibres, sometimes in that of numerous moderately strong radicles, and occasionally in that of comparatively long and powerful vegetable cords. The great body of the bulb consists of the embryo of the plant, and sometimes of nascent bulbs, lodged within a comparatively large and very bulky mass of conservative and nutrient matter, in the form of either convergent and imbricated scales, or of concentric coats or layers, or of an apparently solid and homogeneous mass of vegetable flesh. A bulb with convergent scales, such as that of the common white or orange or martagon lily, is designated scaly or squammose,—*Bulbus squamosus*; one with concentric layers, such as that of the onion, the narcissus, or the hyacinth, is designated coated or tunicated,—*Bulbus tunicatus*; and one with an apparently dense and undivided mass of vegetable flesh, such as that of the crocus or the colchicum, was formerly designated by all botanists and is still designated by some a solid bulb, yet

is now systematically regarded as merely a modification of the tunicated bulb. The scaly bulb, though having an epidermis round each of its scales, possesses no coat or covering round its general mass, and is therefore called a naked bulb; and the other kinds of bulbs, whether consisting of concentric layers or of an apparently solid mass, are invested all round with a strong and fibrous membrane, and are therefore said to be clothed or tunicated. All bulbs propagate their species by forming offsets or young bulbs, which ultimately and spontaneously detach themselves from the parent bulb, and become new and independent individuals. Some, as the crocus, perfect their offsets, and perish, in a single season; and some, as the tulip and the hyacinth, perfect their offsets by slow degrees, produce them in a series of generations, and live through a long series of years. Some, when allowed to lie for years unmolested in the ground, accumulate their offsets above them, so as eventually to raise them above the soil; some accumulate their offsets below them, so as eventually to bury them at an uncongenial and perilous depth below the surface; and most accumulate their offsets around them, so as eventually to form such a dense mass as to starve and choke one another into dwarfishness and decrepitude. Some offsets, as those of lilies and colchicums, are radical, or issue from the axil of the coats or scales, or from the surface of the radical plate; and some, as those of dentaria and bulbifera, are cauline, or issue from the axil of the leaves or umbels. The leaves of a bulbous plant are perfected at the apex, or receive their increments of growth at the base or in contact with the bulb; and the roots or radicles are perfected at the lower extremity, or acquire their increments of growth at their terminating points. If, for example, a small piece of thread be passed through the leaf of a narcissus, it will be carried steadily upwards as the leaf elongates; but if it be passed through a radicle of the same plant, it will remain quite stationary, even though the radicle should attain twentyfold the original length. Dr. A. T. Thomson, who made a series of phytological experiments on this last topic in 1823, concludes, "that the sap must be raised to the apex of the leaf, in order to undergo that change which is necessary to render it, on descending, fit to be assimilated into the substance of the bulb, and that it is from this altered sap that the increase to the leaf is derived; or, in other words, that the apex of the leaf, in bulbiferous plants, performs the same function as the entire leaf in trees and shrubs."

The economy of bulbs, while evidently of great interest, has been the subject of much conflicting and obscure discussion among phytologists; and, in some respects, continues to be badly or not at all understood by the great majority of cultivators. But a recent report of some experiments and observations by the Italian naturalist, Dr. Augustus Trinchinetti, places this topic in a

comparatively clear light, and dissipates much of the obscurity in which it was formerly involved. The bulb of *Crocus sativus* was selected as the subject of Dr. Trinchinetti's immediate experiments, and treated by him as a fair specimen of the whole great family of bulbs. This bulb, as examined in its dormant state, is composed of a parenchymatous starchy substance, and consists of a flattish, globular, central body, and of dry, loosely-fibred coats, succeeding one another like a series of scales, and forming a series of mutually enclosed and gradually larger membranous funnels, easily separable from one another, but all attached at their base. When the funnels are artificially removed, a solid whitish bulb is observed within them, somewhat compressed in the upper part, and marked horizontally with circular lines indicative of the bases of the removed funnels or coats. Near the centre of this inner bulb, or in the middle of the upper part of it, are three or sometimes more cones, formed of finer funnel-shaped coats, under each of which appears, in the form of a small tubercle, the germ of the offset or new bud destined for development in the next growth; and all over the bulb, without any regularity of distribution, are various marks, of different sizes, formed of very fine coats, and containing small germs, which are destined for development according to the healthiness and secretory power of the parent bulb, and which may, in some instances, become abortive when the parent bulb is too small or too feeble to afford them requisite support. When the bulb is cut asunder in its dormant state, it presents to view only a homogeneous milk-white mass, without any apparent organization. When it begins to vegetate, it sends out circumferential fibrous roots, and develops one or more germs, which increase into one or more little bundles, each formed of a sheath with enclosed leaves, and the largest containing also the flower. A slight expansion appears at the base of the little bundles; and this, when cut through lengthwise, discovers a smaller bulb, surrounded by coats, the exterior ones proceeding from the sheaths, the interior ones from the leaves, and both combined forming a small solid substance.

"If," says Dr. Trinchinetti, "when the vegetation has considerably advanced (say about a month after flowering), these small bulbs are again cut through, and a part of the large bulb from which they spring is included in the section, the portion where the coats terminate will be found very much increased in size, and also divided into two parts of different substances; one of which, the germ, is almost of a conical figure, with its base uppermost; it has, in its centre, one or more tubercles; and its point, penetrating downwards, terminates towards the centre of the old bulb, where it joins a similar part proceeding from each of the offsets, and whence the circumferential roots have their origin. This germ is of a yellowish colour and

fibrous structure, and forms the central and lower part of the little bulb, or base of the flower-sheath, which forms above the large bulb. From the structure of this part, its position, and the circumferential and fusiform roots (which will be described presently) proceeding from it, I consider it as the vital speck or germ of the little bundle or sheath which springs from its upper part. The other portion which remains to be described has the appearance of the old bulb, being of a milk-white colour, and of a homogeneous texture, except some threads or filaments in one part, which are more or less apparent, and which cross it vertically, proceeding from each of the tubercles before-mentioned. It has been observed that, as soon as the vegetation commences, the offsets of the bulb send down from their base or side one or more large fusiform roots, which have their origin in the internal part or germ of the solid substance above described. Whether these are intended to assist the circumferential fibrous roots in the office of absorption, need not be discussed here, as it is apparent that these latter cannot absorb sufficient matter for the formation of the offsets; and this is proved more fully by observing that there are sometimes no fusiform roots when only one offset is developed, the circumferential roots in that case appearing to be sufficient for its nourishment. As vegetation proceeds, the offsets are found to augment in bulk; but when observed internally, their germs are found not to have increased at all, and that only the parts which surround them are enlarged; so that, when the bulb is completely developed, the germ has vanished, leaving only a faint trace of shade, showing where it has been, and which may be observed in the lower part of the bulb. In proportion as the offsets become larger, the parent bulb diminishes, becomes yellow and dried up, presenting only a fibrous cellular structure; which, when the new bulb has attained its utmost growth, becomes black, and dwindles away to a very small substance that, sooner or later, disappears altogether. The circumferential roots decay with the bulb, and the fusiform roots also; the leaves become yellow, wither, and finally rot off; and their bases, which have become the inner coats of the dried bulb, with their internal sheaths, remain on the involucre of the offset. The bulb thus passes on into its dormant state. The newly formed bulbs, which at first participated in the vitality of the old ones, (by means of the prolongation of their germs, which united nearly in the centre of the old bulb, and were the origin of the circumferential roots,) now enjoy an individual vitality; they have no longer any germ, as that by degrees has withered, and finally disappeared; and these bulbs, in their turn, can now only be considered as a mass of matter containing the germs of the new plants, which are to be developed at the next season of vegetation."

The bulb of *Gladiolus communis*, the bulb of *Colchicum autumnale*, and even the bulb or tuber of *Corydalis bulbosa* or *Fumaria bulbosa solida*, were observed by Dr. Trinchinetti to vegetate very similarly to the bulb of *Crocus sativus*; except that the offsets of the second of these always appear at the side of the parent bulb, and, having a free base, produce immediate capillary roots, which probably perform the same office as the fusiform roots of the crocus.

Dry solid bulbs, such as those of crocus, if placed on a board or in any other situation, where they cannot form roots or obtain nourishment from the soil or from water, will sprout with great vigour, and, in some instances, will even grow so long and so healthfully as to produce flowers; but they gradually become lighter,—they eventually shrink and shrivel,—and, when they have expended all or nearly all the starchy matter of which their interior substance was composed, both they and their shoots irretrievably perish. When bulbs of the same class grow in the soil or in water, they simply replenish through their roots the successive portions of their interior starchy matter which are consumed in feeding their shoots; and all such bulbs, therefore, additional to their functions of forming germs, defending embryos, and producing offsets, may be regarded as storages of food for the nourishment and maintenance of their respective species of plants, up to a point when reproduction is effected or new individuals brought into existence by the matured formation of offsets. "Whether scaly bulbs and tubers," says Dr. Trinchinetti, "are destined by nature to perform the same office as solid bulbs, I have not yet had sufficient experience to determine. But as they contain a mucilaginous or starchy substance, and as the parts that proceed from them abound in a similar kind of mucilaginous matter, and have all the delicacy of texture mentioned, and as I have observed that the onion, while kept out of the ground, germinates, and continues to grow till it has reduced the bulb to a congeries of withered coats, that the scilla, in a similar situation, will even flower, and that the tubers of the potato put out shoots and nourish them for some time, I think it may be admitted, that not only solid bulbs, but also those that are scaly and tuberous, are intended to nourish the plant with their substance." A twofold inference of great practical moment to agriculture, from this concluding, and, as we think, sound doctrine of Dr. Trinchinetti, is that potato tubers intended for sets ought not to be ripened beyond the mere organic formation of their germs, and that, toward the close of winter and spring, they ought not to be allowed to sprout before being planted, or, in other words, before being placed in a situation to form roots for the replenishment of the starchy matter consumed in the formation of their shoots. How generally have farmers and gardeners observed that, at the time of digging the most productive potato plants,

the sets from which they grew are brought up in such a state of comparative conservation as to indicate that replenishment had long been carried on, and that a large proportion of the nourishing juices from the roots appeared to have passed through the sets? If all bulbs and tubers were viewed as not only the seeds or organic originators of plants, but as the elaborators or stomachs of their root-received food, they would, in many instances, experience different treatment from cultivators than at present, and many of the risks, accidents, and deteriorations of their culture would probably be lessened or even altogether avoided. See the article TUBEROUS ROOTS.

All bulbs, when kept excluded from the atmosphere, are singularly tenacious of vitality. Either a bulb, or a large seed so like a bulb as readily to be mistaken for one, was found, about seventeen years ago, in the hand of a newly unswathed Egyptian mummy, and must have remained in that position during at least two thousand years; and yet, when placed in the soil, it rapidly sprouted and produced a plant. Some bulbs, as those of several species of *Allium*, are used for culinary purposes; some, as certain varieties of scilla and colchicum, are used in medicine; and a vast number enjoy peculiar care and brilliant reputation in the fascinating art of floriculture. Bulbous-rooted flowering plants, in fact, are at once numerous, conspicuous, and exquisitely beautiful or gorgeous members of both the greenhouse and the parterre; and, were all other flowering-plants annihilated or forgotten, this class alone would fill the hearts of the most enthusiastic florists with delight, and be an ample memorial of the floral glories of paradise. The "lilies of the field," the amaryllides, tulips, hyacinths, and many others are familiar examples of the combined magnificence and loveliness of tuberous-rooted plants.

BULBINE. A genus of ornamental plants, of the asphodel family. Though named from a word which signifies a bulb, only a small proportion of the species are bulbous-rooted. The annual species, *Bulbine annua*, is a hardy annual from the Cape of Good Hope. It has a height of only eight or nine inches; its leaves are somewhat long, succulent, tapering, and flattened on their upper side; and its flowers are yellow, grow in loose spikes, and flourish in May and June. This species and about ten others were formerly included in the genus *anthericum*. The bisulcate is a hardy bulbous-rooted species, with yellow flowers, and about a foot high, from New Holland. About twenty other species have been introduced to Great Britain, some from New Holland, but most from the Cape of Good Hope; and all these require greenhouse culture, while the greater number are evergreen herbaceous plants of about a foot in height.

BULBOCASTANUM. See EARTH-NUT.

BULBOCODIUM. A small genus of hardy,

ornamental bulbous-rooted plants, of the melanthium tribe. The spring species, *Bulbocodium verum*, is a native of the Pyrenees, and was introduced thence to Great Britain, during the first half of the 17th century. It has a height of only three or four inches; and produces a purple flower, somewhat like the crocus, in February and March. It loves a shady situation, in peat mould.—The party-coloured species, *Bulbocodium versicolor*, called in the Botanical Register, *Colchicum versicolor*, was recently introduced from the Crimea, and blooms in autumn.—*Bulbocodium* is also the name of a hardy ornamental species of narcissus, which was brought from Portugal in the former part of the 17th century, and which produces a yellow flower contemporaneously with the common daffodil.

BULL. The full-grown male of the ox species. A young male of this species, while sucking, is called a bull-calf; from one year to two years of age, a stirk or a yearling bull; from two to six years of age, respectively a three-year-old, a four-year-old, a five-year-old, and a six-year-old bull; and after six years of age, an old bull. A castrated male is called, after the first year, a stot-calf or stirk-stot, and then a steer; and at four years of age, he is called a bullock.

A bull serves chiefly for the propagation of his species; and though he may be subjected to the yoke, yet he cannot be depended on for working quietly, and may, at times, do enormous mischief by the self-willed and even furious use of his prodigious strength. He is naturally stubborn, intractable, and fierce; and, during the bulling season, he is absolutely uncontrollable, and often ferocious and truculent. A herd of bulls would give utter defiance to all skill of man to tame or manage them; and even a single bull is not unfrequently an object of just terror to a farm or a district. But the male of the ox species appears to possess all his obstinacy and fierceness in strict connexion with the peculiar impulses of his sex; and when he is castrated at an early age, he, without any damage to his constitution or deterioration of his strength, becomes comparatively tractable, patient, docile, and mild, and acquires increasing weight, bulk, unwieldiness, and adaptation to the labours of coarse farm draught. See the articles Ox and CATTLE.

BULLACE-TREE,—botanically *Prunus insititia*. A wild, deciduous fruit-tree, of the plum genus. It grows indigenously in the hedges and woods of Great Britain; it usually attains a height of about twenty feet; its branches are round, irregularly spreading, and generally tipped with straight, sharp thorns; its blossoms are white and rosaceous, and appear in April; and its fruit varies in both size and flavour according to the varieties of the tree,—some is more or less good when dressed, but most becomes much deteriorated when not eaten immediately after being gathered. The bullace-tree is sometimes planted for ornament in shrubberies. The prin-

cipal varieties of it are the white, the black, and the red.

BULL-BAITING. See **BAITING OF ANIMALS**.

BULL-DOG. See **DOG**.

BULLEN. Hemp-stalks freed from the bark.

BULLFINCH,—scientifically *Pyrrhula*. A genus of singing-birds, of the fringillidæ family. The common species, *Pyrrhula vulgaris*, is stationary in most parts of Great Britain, and in many of the northern, western, and central parts of continental Europe, but occurs only as a bird of passage in the countries of southern Europe. It abounds in the mountain forests of Germany; it prefers the gardens, orchards, groves, hedges, and small plantations of Britain to moorlands, commons, uplands, or other waste and uninhabited tracts; and, though an universal and deserved favourite for both its beauty and its song, it works much havoc among some of our choicest wild plants, and conducts a mischievous predatory warfare against the orchardist and the gardener. It feeds, in winter, on seeds, berries, and hips; and, in spring, on the flower-buds of gooseberries, cherries, plums, apples, and medlars, sometimes making such unsparing devastation as to destroy all possibility of a crop. The male bird is velvet black, with a tinge of purple, in the head, wings, and tail; fine bluish grey in the back of the neck and of the body; white, in the rump; roseate, in the cheeks, throat, chest, and sides; and pinkish-white, in the margins of the greater wing-coverts. The female is much duller in the general hues of her plumage, and has only a faint tinge of the roseate colour in the chest. The nest of the bullfinch is usually constructed among low thick bushes or underwood, or on the flat foliage of a spruce or a silver fir; and consists of a basis of birch twigs or other timber-spray, and a shallow basket of flexible radical fibres. The eggs are four or five in number, pale blue, spotted and streaked with pale orange brown. The bullfinch has naturally a soft and plaintive call-note, inaudible at a little distance, and not melodious enough to be entitled song; but he is a brilliant imitator, and possesses a powerful memory; and he can, with comparative ease, be accurately taught either the natural notes of some of our finest singing birds, or some of the most melodious of our artificial airs. He is easily tamed also, and may, in a few days, be made a familiar pet of the household nursery.

BULLIMONG. A mixed crop of oats, pease, and vetches. Old Tusser, in his 'Five Hundred Points of Good Husbandry,' says,

"Where water all winter annoyeth too much,
Bestow not thy wheat upon land that is such;
But rather sow oats or else bullimong there,
Grey pensal, or runcivals, fetches, or tare."

A recorded settlement of accounts between the Rev. John Meadows and one of his tenants in 1661, says, "Shorter's hay and corne this yeare was all paid in kinde. All that he ought me be-

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fore was six pounds, of which I have received three combe, two bushels, and one pecke of bullimong, and all the hay that now lies in the old barne."

BULLING. The pairing of the cow with the bull. See the article **BREEDING**.

BULLOCK. See **BULL**, **Ox**, and **CATTLE**.

BULLRUSH,—botanically *Scirpus Lacustris*. A perennial, aquatic, cyperaceous plant, of the club-rush genus. It grows in streams, clear ditches, ponds, and borders of lakes, in many parts of Great Britain, usually attains a height of about six feet, and produces its apetalous flowers in July and August. It is strictly similar, in both botanical character and general appearance, to the common club-rushes of peaty heaths and mountainous heaths; except that it is so gigantic as to measure feet for their inches. It is used, in manufactories, for making mats, bottoms of rush-bottomed chairs, and other similar articles; and it can be turned to excellent account for various purposes on a farm. The name bullrush is sometimes applied also to the useful British species of the typha genus. See the article **CAT'S-TAIL**.

BULL'S-FOOT. See **COLTSFOOT**.

BULLWEED,—botanically *Centaurea Nigra*. An indigenous perennial-rooted weed, of the knapweed genus. It abounds in many of our pastures; it is common on the sides of our roads; and it too frequently infests our corn-fields and disgraces our husbandry. Its stems are round, streaked, hoary, and usually about 12 or 18 inches in height; its root-leaves are oblong and entire; its stem-leaves are cut or divided; its flowers have a purplish colour, resemble the blue bottle or sweet-sultan in shape, and appear from May till August; and its seeds are small, oblong, reddish, and partly hairy. This annoying plant has many popular names,—among others, cock-heads, black knapweed, and black matfellow.

BUMELIA. A genus of shrubs and trees, of the sapota tribe. The serrated species, *Bumelia serrata*, is a hardy deciduous fruit shrub, introduced from Missouri in 1812, usually attaining a height of about twelve feet, and producing an edible oleaginous fruit of the same family as the medlar. The tough species, *Bumelia tenax*, formerly *Sideroxylon tenax*, is a hardy deciduous timber-tree, of about 25 feet in height, introduced about eighty years ago from Carniola.—The reclinate, the woolly-leaved, the oblong-leaved, and the boxthorn-like species, are hardy, North American, deciduous, ornamental shrubs, of from three to about twelve feet in height, all producing white flowers in the latter part of summer or early part of autumn.—A number of tender species have been introduced to Britain, principally from the West Indies; and two of these, *Bumelia nigra* and *Bumelia salicifolia*, are held in esteem as timber-trees in their native country. Upwards of a dozen other species are known to botanists.

BUNCH. See TUMOUR, FASCIA, FRUIT, and FLOWER.

BUNIAS. A small genus of herbaceous plants, of the cruciferous family. The oriental species, *Bunias orientalis*, is a native of the Levant, and was introduced thence to Britain in the former part of last century. It is a hardy perennial, and has challenged attention as a forage agricultural plant. It usually grows to the height of about twenty inches; its branches, leaves, and general habit of herbage are somewhat similar to those of the wild chiccory; and its flowers are yellow, and appear from May till July. It was tested as an agricultural plant, and compared with other herbage plants, in the Woburn experiments; and was found to be well adapted for mowing, to be less productive than chiccory, and to contain, bulk for bulk, the same proportion of nutritive matter as red clover.—The erucage species, *Bunias erucago*, was introduced from Austria in 1640. It is an annual, grows to the same height as the oriental species, and flowers in June and July. Its branches are numerous and spreading, and incline toward the ground; its leaves are glaucous, deeply divided, and almost like those of swine's cress; and its flowers are small, pale-yellow, and produced singly from the wings of the leaves toward the extremity of the branches.—The only other species at present ranked as a bunias, is the rough species, an annual from Portugal; and other plants formerly classed under this genus are now assigned to the genera *muricaria*, *oethodium*, and *euclidium*.

BUNIAM. See EARTH-NUT.

BUNS. Cylindrical stems of any kind; but particularly the stems of hemp freed from their bark.

BUNT. See SMUT and *ÆCIDIUM*.

BUPALUS. A genus of insects, of the moth tribe. One of the species, *Bupalus piniarius*, infests our pine woods, and often commits great depredations upon the Scotch pine and the spruce firs. Towards the close of last century, it made enormous havoc in the pine forests of Bavaria, Saxony, and Pomerania; and in 1832–3, it utterly destroyed about one hundred acres of fir-trees in the forest of Hagenau near Strasburg. Its eggs are laid on the foliage and spray of the trees; and its larvæ are hatched in from four to six weeks, and grow and eat till their transmutation into chrysalides late in autumn. The insect usually appears in June. The male is smaller than the female; his body is very slender, and about six lines in length; his wings expand about an inch and a half; his upper wings are dark brown, with a dull yellowish triangular spot on each; his under wings are yellowish-white, dotted with dark brown, and crossed posteriorly by two bands; and his antennæ are brownish-black, and deeply pectinated. The female is so dissimilar to the male as to be very liable to be mistaken for a different species; her upper wings have a ground colour of rusty yellow,

low, with two light brown cross stripes; her under wings are similar to those of the male, but have the markings imperfect and indistinct; and her antennæ are simple and filiform. The larva, in its earlier stages, is green; but afterwards acquires five longitudinal stripes, the dorsal one white, and the others white with a greater or less degree of yellow tinging. When young, it merely breaks the epidermis of the pine and fir leaf; but when full grown, it eats the entire leaf. The larvæ are fondest of young trees; but they do not travel in search of food; for when they have eaten up all the foliage of a grove or district, any of their number which are not ready for transmutation into chrysalides perish.

BUPLEURUM. See HARE'S EAR.

BUR. The rough, prickly, adhesive seed-vessel of the burdock. See BURDOCK.

BURDEN. A load, an impost, or a reservation of property. In its literal sense of a load, a burden is any heavy mass of matter borne by man or one of the lower animals; and hence all brutes which are accustomed to carry loads are called beasts of burden. In the sense of an impost, a burden is a tax upon industry, or a legal exaction from the profits of labour; and in the sense of a reservation of property, it is a stipulated or enforced deduction from the income of an estate.

BURDOCK,—botanically *Arctium*. A genus of herbaceous plants, of the thistle division of the composite tribe. The smooth-leaved or greater species, *Arctium lappa* or *Arctium majus*, is a biennial weed of Great Britain. It abounds in many waste places, and is not unfrequent by the sides of roads and in similar situations. Its root is simple, spindle-shaped, externally brown, and internally white; its stem is succulent, ramose, and about 3 or 3½ feet high; its leaves are cordate, undulated, very large, dark green above, whitish below, and standing on long footstalks; its flowers consist of purple uniform florets, are produced in terminal panicles, and appear in July and August; and its fructification comprises a punctured receptacle, rough and prickly seed-downs, and quadrangular seeds, and is externally armed all over with adhesive prickles which make it stick to the clothes of passers-by, and render it an implement of frolic and mischief in the plays of children. The roots contain inuline; and the stems and leaves contain nitrate of potash. The roots and seeds possess diuretic properties, and are said also to determine to the surface without exciting nausea or increasing irritation. They have a place, though an obscure one, in the pharmacopœia; and the roots are used in decoction by the peasantry of the south of England as an antiscorbutic. The leaves are employed in making the green elder ointment, which has long been much used by farriers.—The woolly-headed species, *Arctium bardana* or *Arctium tomentosum*, is also a biennial weed of Great Britain; and grows in similar situations, and has similar

habits, appearance, and height, to the smooth-leaved species. Both are very cumbrous weeds, endowed with very prolific powers of propagation, and making war of exactly the same kind upon farmers as docks and the larger thistles; and they require to be combated by stubbing, so as to prevent their going to seed.—Another species, called the smaller, growing to the height of about two feet, is common as a biennial weed in some other countries of Europe.—Burdock is also the popular name of a curious annual grass, about a foot in usual height, which was introduced to Great Britain from the East Indies in the latter part of last century. This grass constitutes a genus of itself, and is called by Linnaeus *Cenchrus lappaceus*, and by Desvaux *Cenotheca lappacea*.

BURDOCK (SMALL). See BURWEED.

BURGLARY. A term in criminal law, supposed to be derived from the German *burg*, 'a house,' and *larron*, 'a thief,' or the Latin *latro*. It is defined to be a breaking and entering the mansion-house of another, in the night, with intent to commit some felony within the same, whether such felonious intent be executed or not. This is the modern signification of the term, which formerly applied, also, to the breaking into a church, fort, or town; and the breaking into a church is said, by Sir William Blackstone, to be, undoubtedly, burglary. Both breaking and entering are considered necessary to constitute the offence. The opening a door or window, picking a lock, or unlocking it with a key, raising a latch, or loosing any fastenings, constitutes a breaking. Likewise, knocking at the door, and, on its being opened, rushing in, has been so considered. So, if a lodger in the same house open and enter another's room; or if a servant conspire with a robber and let him into the house, it will be such a breaking of the house, as, if done with intent to commit a felony, will be burglary. The breaking and entering must, however, be in the night, to make it burglary; and, according to Lord Hale's opinion, if there be enough of daylight in the evening, twilight or dawn for discerning a man's face, it will not be burglary. But this does not extend to moonlight, since such a construction would secure impunity to many burglaries. The breaking open of a barn, shop, shed, or other building, is not burglary, unless it be appurtenant to a dwelling-house. A chamber in a college, or in the London inns of court, is, for this purpose, considered to be a mansion house. The British statute 7 & 8 Geo. IV., cap. 29, makes the punishment death; and this statute, pursuing that of 12 Anne, cap. 7, makes the committing a felony in a house, and breaking out of it by night, burglary. This statute of Geo. IV. also alters the definition of the crime, by substituting dwelling for mansion-house. It also defines what shall be considered as part of the house, saying, that no building within the same curtilage, and occu-

pied with the dwelling-house, shall be deemed a part of it for this purpose, 'unless there shall be a communication' with the house 'by means of a covered and enclosed passage.' This act also provides that, "if any person shall *break and enter* a house and steal," &c., or "shall steal any property in any dwelling-house, any person *therein being put in fear*," or "shall steal to the value of £5," he shall suffer death; and it does not appear, by Mr. Collier's edition of the criminal statutes, 1828, that any distinction is made, in this section, as to the offence being by day or night. This crime is punishable, under the French code (Penal. lib. 3, tit. 2, c. 2, s. 1, No. 381, 383), either by death or by hard labour for life, according to the circumstances of aggravation.

BURGUNDY PITCH. The resin of the Norway spruce fir. It is obtained by making incisions through the bark to the alburnum. Flakes of it are formed by concretion at the edges of the wounds; they are detached, and fresh incisions made, once a fortnight during summer, and they are melted with water in large boilers, and afterwards strained through coarse cloths under a press. The greater portion of the Burgundy pitch brought to Great Britain, is imported in casks from the neighbourhood of Neufchatel. An adulterated kind of it, or artificial imitation, is very generally sold in the shops under the name of common Burgundy pitch; but this may easily be distinguished by its friability, and by its want of the proper odour, unctuousity, and viscosity. The genuine sort somewhat resembles yellow resin, but is opaque, unctuous, and agreeably fragrant. Burgundy pitch is somewhat extensively used by farriers in some of their ointments, and especially in making 'charges' and strengthening plasters.

BURNBAKING, or BURNBEATING. See PARING and BURNING.

BURNET,—botanically *Poterium*. A genus of evergreen herbaceous plants, of the rosaceous tribe. The common or Sanguisorba species, *Poterium sanguisorba*, constitutes a large portion of the natural herbage of the South Downs, and grows wild on other chalky hills of England; it, at the same time, possesses considerable importance in cultivation as both a salad and a forage plant; and it gives the botanical name *poterium* or 'cup' to the whole genus, in consequence of its being used in cool tankards or cooling drinks. Its stem is angular, smooth, and leafy, and usually attains a height of about two feet; its leaves are smooth, pinnate, and glaucous-green; and its flowers are green, and appear in July,—some of them barren, and having elegant crimson stamens somewhat like silk tassels.

The leaves of this plant are used in Britain as both a winter and a spring salad, and as a small culinary herb; and is in very high esteem as a salad among the French and the Italians,—so high indeed among the latter, that an Italian

proverb affirms it to be essential to every good salad. It tastes and smells like cucumbers, and is therefore used to flavour other salads; and produces slightly cheering and even exhilarating effects. It naturally delights in calcareous soil, yet thrives in either sandy ground or fine gravel; and it requires, within the garden, to be cultivated in some kind of decidedly light, and, if possible, calcareous soil, both poor and dry. A small bed of it is sufficient for a family; and this ought to be selected in some exposed spot; and, if naturally loamy or otherwise rich, it ought to be largely impoverished with an intermixture of chalk, bricklayer's rubbish, or sand and gravel. When propagated from seed, it may be sown either in autumn as soon as the seed is ripe, or in any open weather between the latter part of February and the end of May; but when sown in spring, it is liable either to fail or to lie unsprung till the following year. It may be sown either broadcast, or in drills six inches asunder, but, in either case, not more than half an inch deep. The plants, when two or three inches in height, may be thinned to distances from one another of six inches; and, when fully matured, they should be occasionally cut down in summer, to promote the growth of young shoots. Slips or partings of the roots may also be used for propagating salad burnet; and these should be planted in September or October, and occasionally watered till they become fully established.

Common burnet, as a forage plant, was at one time extolled as of wondrous value, but has proved, from manifold experiment and prolonged trial, to be of but limited and comparatively small importance. It was brought into notice as an agricultural plant, about the middle of last century, by Mr. Rocque of Walham-Green; and it made the same kind of sensation among the agriculturists of England, which the fiorin of Dr. Richardson made at a later period among the agriculturists of Ireland. Even in one of the best known works of the justly celebrated Arthur Young, published so late as the year 1804, so singularly laudatory a passage respecting it as the following occurs:—"Burnet, I am fully persuaded, will prove a very great acquisition to husbandry on many accounts, but more particularly for the following reasons. Burnet is a good winter pasture; consequently it will be of great service to the farmer, as a constant crop he may depend upon, and that without any expense for seed or tillage, after the first sowing. It affords both corn and hay. Burnet seed is said to be as good as oats for horses. I know they will eat it very well; judge then the value of an acre of land which gives you at two mowings ten quarters of corn and three loads of hay. The seed indeed is too valuable to be put to that use at present; though it multiplies so fast, that I doubt not but in a few years the horses will be fed with it. It will bear pasturing with sheep. It makes good butter. It never blows or hoves cattle.

It will flourish upon poor, light, sandy, stony, shaltery, or chalky land. Burnet, after the first year, will weed itself, and be kept clean at little or no expense. The cultivation of burnet is neither hazardous nor expensive; if the land be prepared, as is generally done for a crop of turnips, there is no danger of any miscarriage, and any person may be supplied with the best seed at 6d. per pound." But the only truly valuable properties of burnet as an agricultural plant are its adaptation to very poor soils, its sturdy resistance of the severest frosts of winter, and its yielding early spring herbage to stock. Both in weight of produce and in proportion of nutritive matter, it is much inferior to the clovers and to other leguminous herbage plants. When made into hay, and when unmixed with other herbage, it is coarse and unpalatable. Even in its succulent or growing state, if uncombined with grasses or clovers, it is rejected by all animals except when they are voracious with hunger. It is much and profitably grown by stock farmers, particularly by upland sheep farmers, as an important element of food in the scarce and pinching season of early spring; it enjoys a just reputation as the very best adapted of all known forage plants for maintaining a winter verdure, and resisting the severest frosts in bleak and exposed situations; and when grown mixedly with the grasses of hill pastures, it is always eaten close to the ground by sheep and cattle, and is believed to exert upon them the influences of a tonic and an aromatic. When intended for hay on low grounds, or for summer pasture on uplands, it ought to be mixed with some of the grasses or with white clover; and, when grown on very poor chalky soils as the most profitable herbage likely to be supported by their semisterility, it ought to be combined with *echinocloa crus-galli* and small quantities of *schedonorus pratensis* and perennial fescue. About three pecks of burnet and one bushel of *echinocloa crus-galli* are suitable for an acre; and the proper time of sowing is April. Mr. Young recommends that about a bushel of burnet per acre should be sown in April, with either barley or oats, and covered at two harrowings; and he teaches also that it may be sown with buckwheat in May.

Several varieties of the common burnet are in cultivation, particularly two with respectively smoother and less smooth leaves, and a third with larger seeds than either of these two; but all are inconstant and merely seminal.—The sweet hybrid, the polygamous, and the agrimony-leaved species, all hardy herbaceous species, the first from France, the second from Hungary, and the third from Spain, are occasionally grown in British gardens as ornamental plants. The tailed species and the prickly species, both small evergreen shrubs, the former from the Canaries, and the latter from the Levant, may be met with in some British greenhouses.—*Smith.—Miller.*—

Loudon.—*Mace.*—*Mill's Husbandry.*—*Young's Farmer's Calendar.*—*Lowe's Agriculture.*—*Doyle's Husbandry.*—*British Husbandry.*—*Society of Gentlemen's Complete Farmer.*

BURNET-SAXIFRAGE,—botanically *Pimpinella*. A genus of hardy, herbaceous plants, of the umbelliferous family. Three perennial-rooted species grow indigenously in England; six perennial-rooted species have been introduced from various parts of Europe; and one biennial species, the round-leaved, has been introduced from the Caucasian mountains. The great species, *Pimpinella magna*, grows naturally in woods, and on the sides of banks near hedges in several parts of England. Its stems ramify into four or five branches; its lowest leaves consist each of three pairs of heart-shaped leaflets, and a terminating odd one,—the leaflets sharply sawed, and sitting close to the midrib; the leaves of the lower part of the stems are similar in shape to the preceding but smaller; the leaves of the branches are trifid and short; and its flowers have a white colour, are produced in small compound umbels at the ends of the branches, and bloom from June till August. A seminal variety of this species, with red flowers, frequently rises in mixture with the normal plant; and a permanent variety with cut leaves, *P. m. dissecta*, was introduced about forty-five years ago from continental Europe.—The saxifrage species, *Pimpinella saxifraga*, grows naturally on dry pastures in many parts of Great Britain. Its stems are nearly a foot in height, and send out three or four slender branches; its lower leaves consist each of four pairs of roundish leaflets and a terminating odd one; and its umbels, flowers, and seeds are smaller than those of the preceding species.—The cut-leaved species, *Pimpinella dissecta*, grows naturally in dry gravelly pastures in several parts of England. Its stems are slender and about fifteen inches in height; its branches are small, and have a narrow trifid leaf at each joint; its lower leaves consist each of five or six pairs of very deeply cut leaflets, and a terminating odd one; and its umbels of white flowers are small, and consist of several rays standing upon pretty long footstalks.

BURNING OF HEATH. See **HEATH**.

BURNING OF LAND. See **PARING** and **BURNING**.

BURNING OF LIME. See **LIME**.

BURNS. Excoriations and inflamed wounds inflicted upon animals by fire. They should be frequently and very gently washed with a mixture of equal parts of lime-water and linseed oil.

BURNT-CLAY. See **ASHES** and **BURNT-EARTH**.

BURNT-EAR. See **BRAND** and **SMUT**.

BURNT-EARTH. Calcined and incinerated coarse soil. It is frequently confounded with burnt clay; but may, in every case, be readily distinguished by its containing the ashes of vegetable matter. The burning of clay is mere calcination; while the burning of earth, in the

technical sense of the phrase, is both calcination and incineration. See the article **PARING** and **BURNING**. When burnt earth is applied as a manure, and made the subject of valuation, it is allowed for according to the quality of the constitutional ingredients, the mode of burning, and the cost of labour and fuel; but, in a general or average view, "full tillage is allowed when applied on fallow or turnips, and if valued before producing a crop,—and half tillage after one corn crop,—and after two crops, the valuation ceases."—*Dayldon on Rents and Tillages*.

BUR-PARSLEY,—botanically *Caucalis*. A genus of herbaceous plants, of the umbelliferous tribe. The broad-leaved species, *Caucalis latifolia*, is an annual weed of the chalk districts of England, and one of the most remarkable and handsome plants of the genus. Its stem is branched, usually about three feet in height, and armed with small ascending prickles; its leaves are rough, yet somewhat glaucous; its flowers have a bright reddish pink colour, are inversely heart-shaped, and appear in July and August; and its fruit is armed with double rows of purplish, straight, rough bristles.—The carrot-like species, *Caucalis daucoides*, is also an annual weed of the chalk fields of England. Its root is small and tapering; its stem is branching, bushy, and about 18 inches high; its leaves are nearly smooth; its flowers are red, and appear in June; and its fruit is oblong, large, and very hairy.—Both of these species are mere weeds, unfit for conversion to any other useful purpose than manure, and requiring to be pulled up before they form their seed. Several hardy exotic annual species have at various times been introduced from the shores of the Mediterranean and the mountains of Caucasus; but they possess neither beauty nor utility.

BUR-REED,—botanically *Sparganium*. A genus of perennial, aquatic, reedy plants, of the cat's-tail tribe. The floating species, *Sparganium natans*, inhabits the fens of England; the alpine species, *S. alpinum*, the pools and ditches of the Scottish mountains; the simple species, *S. simplex*, the stagnant waters of Britain; and the branchy species, *S. ramosum*, the ponds and ditches of Britain. The first and the second are floating plants; and the third and fourth usually grow to the height of respectively 20 and 25 inches. All are monœcious, creeping-rooted, and smooth, and produce apetalous flowers in July. The herbage of the branchy species is softer and more pliant than that of most of the reedy plants, and serves well, in combination with some of them, for the purposes of package. A strong decoction of the unripe fruit is very astringent, and has been recommended as a wash for old ulcers.

BURROW. A heap or small artificial mound. "Peat-burrows" and "stone-burrows" are familiar applications of the word.

BUR-TREE, or **BOR-TREE**. The elder tree.

BURWEED,—botanically *Xanthium*. A genus of hardy annual plants, of the ambrosia division of the composite tribe. The small burdock, *Xanthium strumarium*, is occasionally found on dunghills and pieces of very rich moist ground, in the south of England. Its root is fibrous; its stem is solitary, erect, branched, leafy, coarse, shrubby, and about three feet high; its leaves are heart-shaped, and stand on long footstalks; and its flowers are green and inconspicuous, and appear in July and September. This plant was formerly used as an antiscorbutic, but has totally lost its medicinal reputation. Six species—three of them interesting to the botanist, though useless to the economist—have been introduced from other countries. Some one of the species was used by the Greeks to produce a yellow dye; and from this circumstance arose the generic name *Xanthium*.

BUSH. A shrub, or a mass of shrubby plants, or a thicket; also, the box of the nave of a wheel.

BUSH-DRAINING. A kind of draining in which the drains are filled with bushes. See **DRAINING**.

BUSHEL. A measure of capacity for grain, pulse, fruit, and many other kinds of dry goods; and particularly the ruling or basis measure of all corn. The standard or legal bushel in England, from the time of Henry VII. till the year 1826, was the Winchester bushel; and, by act of parliament passed in 1697, a Winchester bushel was required to be a round vessel, with a plain and even bottom, 8 inches in depth and $18\frac{1}{2}$ inches in diameter, and, in consequence, to have a capacity of 2150.42 cubic inches. This bushel, like the imperial one now in use, contains four pecks or eight gallons, and is the eighth part of a quarter, or fortieth part of a load.

But besides the Winchester or legal bushel, several bushels of different dimensions were in use within certain districts, and still occasionally make a figure in the statistics of dry measure. The Abingdon and Andover bushel for all corn and pulse contains 9 gallons; the Penrith and Appleby bushel for wheat, rye, and pease, contains 16 gallons; the Penrith and Appleby bushel for oats, barley, bere malt, and mixed malt, contains 20 gallons; the Carlisle bushel for all grain and pulse contains 24 gallons; the Chester bushel for wheat, rye, and some other produce, contains 32 gallons; the Chester bushel for oats contains 40 gallons; the Dorchester bushel for oats and malt contains 10 gallons; the Kingston-upon-Thames bushel contains $8\frac{1}{2}$ gallons; the Reading and Wycombe bushel contains $8\frac{3}{4}$ gallons; the Stamford bushel contains 16 gallons; and the Falmouth bushel contains, for different articles, variously 16, 20, and 21 gallons. The legal coal bushel, appointed by statute of 13 and 14 William III., cap. 5, to be used in London, Westminster, and every place within ten miles of these cities, and generally used throughout England previous to 1826, con-

tained one Winchester bushel and one quart of water, or 2217.62 cubic inches, and was made round, with an even bottom, and $19\frac{1}{2}$ inches in diameter; and, as it was ordained to be heaped up in the form of a cone, 6 inches above the brim, it gave a space for the coals of 2814.9 cubic inches. An act of Henry VII. required each of the eight gallons of the legal or Winchester bushel of wheat to weigh 8 pounds troy, the pound weighing 12 ounces, the ounce 20 sterlings, and the sterling 32 grains.

The act of Weights and Measures, 5 George IV., cap. 74, declared the imperial gallon to be the standard measure of capacity, and appointed the level bushel of eight imperial gallons to be the ruling measure of corn and similar articles, and the bushel of eight imperial gallons, heaped up in the form of a cone to the height above the rim of at least three-fourths of its depth, to be the ruling measure of coals, culm, lime, potatoes, fruit, fish, and all other dry goods usually sold by heaped measure. But by act 4 and 5 William IV., cap. 49, which came into practice on the 1st of January 1835, the heaped bushel was abolished. The standard imperial gallon contains 10 avoirdupois pounds of distilled water, weighed in common air of 62° Fahrenheit, the barometer standing at 30; or it contains 277.274 or a minute fraction more than $277\frac{1}{4}$ cubic inches. The imperial bushel, therefore, contains 80 lbs. of distilled water, or 2218.192 cubic inches; and is to the old legal or Winchester bushel as 1 to .969447. A general table of the subdivisions and multiples of this bushel may be stated thus:—

4 gills	= 1 pint, containing	$34\frac{1}{2}$	cubic inches.
2 pints	= 1 quart, —	69	— —
4 quarts	= 1 gallon, —	$277\frac{1}{4}$	— —
2 gallons	= 1 peck, —	554	— —
4 pecks	= 1 bushel, —	2218	— —
8 bushels	= 1 quarter, —	10	cubic feet.
5 quarters	= 1 load, —	51	— —

One imperial bushel of fine wheat will weigh 63 lbs.; but inferior sorts will not exceed 53 lbs. The average weight is rated at 60 lbs. Five such bushels make a sack = 300 lbs.; Eight such a quarter = 480 lbs.; Forty such, or 5 quarters = 2400 lbs. = $1\frac{160}{1000}$ ton. Fine oats will weigh 42 lbs., ordinary, only 36 lbs. per imperial bushel. Fine barley weighs 56 lbs.; good 52 lbs.; and ordinary, 48 lbs. per imperial bushel. A bushel of American Indian corn weighs 56 lbs.; and five such, or 280 lbs. form a sack; but the average weight of European Indian corn is 60 lbs. per imperial bushel.

"Merchants," says Mr. Stephens, "know the weight of grain by its appearance and feel, and therefore, by trying the weight of a 4-bushel sack, they can easily ascertain whether the grain is in as clean a state throughout the whole bag as at its mouth. But the introduction of the weight has given rise to a species of deceitful dealing as regards the public. The purchaser offers a certain price for every so many pounds weight of

the grain, without direct reference to the contents of the bushel; and some farmers are induced to sell on this plan, in the vain hope of being able to boast that they have sold their grain at such a price, wishing it to be believed that the price applies to the true quarter, when in fact it is given for so many pounds weight; and to deliver the number of pounds for the specified sum, the bushel is heaped. This is pitiful work. The fair and common practice is to ask such a price for the grain per quarter, stating its weight by the bushel; and of course, the heavier the grain, and better the quality, the purchaser will give the higher price for it."

BUSH-HARROW. A frame of wood interwoven with cut shrubs or with the croppings and smaller branches of trees, and used for softly and sparsely harrowing grass lands. The frame consists of two end pieces and three or more cross-bars; and the interwoven bushy matter is of such a kind as to present to the ground a dense, rough, and brushy surface. The bush-harrow is, in many instances, moved upon two wheels, about a foot in diameter, and attached to the extremity; but, in other instances, it is dragged along as an unassisted, horizontal mass. A frequent substitute is a common heavy harrow, with strong and pliant branches of trees or some hedge-row thorns woven through its open squares; and another and vastly better substitute is an upright series of branches in a frame in the front of the carriage of a common roller. The prime uses of the bush-harrow are to spread manurial top-dressings sparsely and equally upon grass-lands, or, after the removal of the cattle for the season from pasture-fields, to make an equal distribution of the mossy matter, the worm-casts, and the mimic heaps of mould which exist upon the surface; and, in either case, it ought, in most instances, to be followed by rolling, in order that the land may be laid smooth for mowing, that spongy and porous soils may be somewhat consolidated, and that a firmer and hardier bottom may be given to the sward. Now when a series of upright branches in a frame in front of the roller is used as a substitute for a bush-harrow, the whole process is performed by one horse and one driver, while the use of the harrow and the roller as separate implements requires two horses and two drivers; and when the upright branches are somewhat worn, they can be moved farther down so as to continue in a regular manner the sweeping action upon the ground, while the horizontal bushy surface of either the formal bush-harrow or the common heavy-harrow substitute, soon becomes flat and smoothened so as to lose its power of spreading the earth. But some implements are expressly constructed by the machine-maker to perform the work of the bush-harrow. See the article **HARROW**.

BUSH-VETCH,—botanically *Vicia sepium*. A forage plant, of the vetch kind. Its root is perennial, fibrous, and ramified; its stems are nu-

merous,—some growing erect from the crown of the root, and some rising at various distances, from decurrent or ramose members of the root; its leaves are small and oval, and sit upon mid-ribs, each of which terminates in a tendril; its flowers are reddish-purple in colour, have the same kind of papilionaceous form as those of the common vetch, and appear in the middle of May; its pods have a black colour when ripe, and are flatter and much shorter than those of the common vetch, yet larger in proportion to their length; and some of its seeds are speckled, some have a clayey colour, and all are smaller than those of the ordinary vetches. "Being a perennial," says Mr. Swayne, "it should seem to be a very proper kind to intermix with grass seeds for laying down lands intended for pasture; and that it is as justly entitled to this epithet as any herbaceous plant whatever, I think I may be allowed to affirm, having observed a patch of it growing in one particular spot of my orchard for these fourteen or fifteen years past. It is not only a perennial but an evergreen; it shoots the earliest in the spring of any plant eaten by cattle with which I am acquainted, vegetates late in autumn, and continues green through the winter, though the weather be very severe; add to this, that cattle are remarkably fond of it. These peculiarities, it should seem, would make it particularly valuable to the farmer as a green food for his sheep in the winter and spring, when food of that denomination is so exceedingly scarce. Indeed, I had often wondered within myself, what could be the reason that this plant had never found its way into general cultivation for this purpose; but since I have been acquainted with some peculiar circumstances attending it, my wonder has ceased. From these I collect, that the chief reason which has hitherto prevented its cultivation, has been the very great difficulty of procuring good seeds in any quantity. The pods, I find, do not ripen altogether; but as soon almost as they are ripe they burst with great elasticity, and scatter the seeds around; and after you have procured the seeds, scarce one-third part of them will vegetate, owing to an internal defect, occasioned by certain insects making them the nests and food for their young." [The Bath Society's Letters and Papers, Vol. III.] This plant, when grown upon brown sandy loam, yields per acre 17,696 lbs. of green produce, and 976 lbs. of nutritive matter. It is not suited for clayey lands, but retains long and steady possession of other kinds of soils. A mowing of it may sometimes be obtained so early as the beginning of March; and three or four mowings of it may usually be obtained in the course of a year.

BUSTARD. The trivial name of a species of wader belonging to the genus *Otis* of Linnæus, and to the family *Pressirostres* of Cuvier. The great bustard, *Otis tarda*, is the largest of European land-birds, the male weighing, on an aver-

age, 25 pounds. It is four feet in length, and measures nine feet from tip to tip of the wings. The head and neck are ash-coloured, and there is a tuft of feathers about five inches long on each side of the lower mandible. The back is transversely barred with black and bright ferruginous colours, and the primaries are black. The tail consists of 20 feathers, broadly barred with red and black. The belly is white, the legs dusky, naked, and without a hind toe. The female is but half the size of the male, and has the crown of the head of a deep orange colour, traversed by red lines; the remainder of the head is brown. She otherwise resembles the male except that the colour of her plumage is less bright. This species is found in most of the open and level countries of the south and east of England, where they are occasionally seen, in autumn, in flocks of 50 and upwards. They are very shy and vigilant, and by no means easy to shoot. They run with great speed, and aid their course with their wings, like the ostrich. Although they rise on the wing with difficulty, they are said to fly many miles without resting. They feed on grain, seeds, worms, &c., and lay two eggs as large as those of a goose: these are of a pale olive tint, with dark spots. The nest is merely a hole scraped in the earth. They do not wander far from their accustomed haunts, seldom going to a greater distance than 20 or 30 miles. Their flesh is considered fine eating.

BUTCHER'S BROOM. See **BROOM** (**BUTCHER'S**).

BUTEA. A genus of ornamental and economical evergreen East-Indian trees, of the pea division of the leguminous tribe. Only three species are known, the frondose, the superb, and the small-flowered; and all, within the last half-century, have been introduced to the hothouses of Great Britain. The small-flowered usually attains a height of about 20 feet, and the other two a height of about 30 feet; and all carry scarlet flowers, and have an imposing and brilliant appearance. The frondose species is generally known in India under the name of *Porasum*, and is much valued for several economical purposes. Its flowers, either alone or in conjunction with those of the sorrowful *nyctanthes*, are used by the dyers for dyeing a beautiful bright yellow. Dr. Roxburgh, with the juice of the fresh flowers, diluted in alum-water, and clarified by depuration, prepared a soft extract which proved a brighter water-colour than any gamboge he had ever seen. The seed is produced within a very flat, oval, chestnut-coloured legume, and is held in high estimation by the Tamul physicians as a remedy against tapeworm and ascarides. Dr. Roxburgh states that, from fissures and wounds made in the bark of the tree issues a beautiful red juice, which soon hardens into a brittle, ruby-coloured, astringent gum, which he thinks might prove a valuable medicine.

BUTOMUS. A small genus of elegant, aquatic,

flowering plants, of the rush tribe. The two genera *butomus* and *limnocharis* constitute the natural order *butomeæ*; and this order has an alliance with the orders *alismaceæ* and *juncaginææ*. The name *butomus* is derived from two words which signify "an ox" and "to cut," and alludes to the fact of the best known species lacerating the mouths of oxen which crop it. The umbelled species, *Butomus umbellatus*, is a native of Britain, and boasts the fame of being the most beautiful aquatic plant of our country, and has long been popularly designated the flowering-rush and the water-gladiole. It grows wild in ditches, ponds, and sides of rivers, which have a gravelly bottom. Its stems are round, very smooth, and two or three feet in height; its leaves are narrow, acute, and nearly as long as the stems; and its flowers have a pink or rose colour, grow in large bracteated umbels, appear in June and July, and produce an imposing affect. This plant acquired for some time, in Russia, the factitious and absurd fame of being a remedy for hydrophobia. It may be propagated either from seeds or by a division of the roots in ponds, in small artificial bogs, or in cisterns of proper depth, having a twelve-inch stratum of soil at their bottom, and filled thence to the top with water. A variety of this species has white flowers; but it is not constant.—The broad-leaved species, *Butomus latifolius*, was introduced about twenty-two years ago from Nepaul. It is a hardy, perennial, elegant aquatic, producing white flowers, and only about half the height of the umbelled species.

BUTTER. A fat unctuous substance, usually prepared from the cream of cow's milk by agitation. It is of a yellow colour, possesses the properties of an oil, and readily mixes with other oily bodies. The process by which it is obtained from cream, is that sort of agitation called *churning*, well known to everybody. When pure, it is soft and concrete, and of an agreeable sweet taste. It melts at the temperature of 96°, and becomes transparent; but if it be kept for some time in this state, a portion of curd and water, or whey, is disengaged, and it assumes exactly the appearance of oil. It has now, however, lost almost all its peculiar flavour.

The word butter is no doubt derived from the Latin *butyrum*; and that from the Greek. Hippocrates is the first Greek author who mentions butter. Speaking of the Scythians, he says, "they pour the milk of their mares into wooden vessels and shake it violently; this causes it to foam, and the fat part, which is light, rising to the surface, becomes what they call butter." Herodotus also, who was contemporary with him from the year B. C. 459 to B. C. 413, particularly describes the process of making butter among the Scythians. This affords a presumption that the article was not then known among the Greeks, and that they acquired the knowledge of it from the Scythians. Some have imagined that they found butter mentioned in the writings of Moses, the book of Job, and other parts of the most ancient sacred Scriptures. According to our translation, Abraham is said, Gen. xviii. 8. to have taken *butter*

and milk, and the calf that had been dressed, to set before the august strangers who visited him. And in the well-known song, or historical ode of Moses, which he recited in the hearing of the Israelites, a short time before his death, (Deut. xxxii. 14.) we have the words "butter of kine." Butter is also mentioned in the song of Deborah and Barak, Judges v. 25. Certain friends (2 Sam. xvii. 29.) are said to have brought to Mahanaim, butter and other articles, for the refreshment of David and his army during the rebellion of his son Absalom. Honey and butter are also mentioned Job xx. 17; and in chap. xxix. 6. he says, "When I washed my steps with butter, and the rock poured me out rivers of oil." Butter and honey are also mentioned in the well-known passage in the 7th chapter of Isaiah, where the prophet foretells of the child, that he should eat butter and honey. And in the 30th chapter of the Proverbs it is said, "the churning of milk bringeth forth butter." But it is to be observed, that in all these passages, the Hebrew word rendered butter is *hemde*, which Biblical critics agree in allowing to signify sour thick milk or cream. Besides, it is plain that *hemde* alludes to something fluid, for it was used to wash the feet. The error of supposing *hemde* to mean a concrete substance like butter, appears to have arisen from the Septuagint, who translate the Hebrew term by *βούτυρον*, a word which, as they lived in Egypt two centuries after Hippocrates, they might no doubt have heard of, and supposed to correspond to the Hebrew word *hemde*. That they meant, however, no more than cream by the term is highly probable. No doubt, the common translation of the passage already quoted from the Proverbs, may be thought to prove clearly that the making of butter by churning was well known among the Hebrews. But the original words signify to squeeze or press; and might have been as well translated "the pressing of the milker bringeth forth milk." And this accords better with what immediately follows, viz. "and the wringing of the nose bringeth forth blood."

It was late before the Greeks appear to have had any knowledge of butter. No mention is made of it by any of their early poets. Homer, Theocritus, and Euripides, though they frequently speak of milk and cheese, say nothing of butter: and Aristotle, in his 'History of Animals,' at first assigns to milk only two component parts, viz. the serous and the caseous; though afterwards he remarks, as it were by the bye, that there is likewise found in milk a fat substance, which, under certain circumstances, is like oil. Hippocrates, as we have already remarked, is the first Greek writer who mentions butter; and he frequently prescribes it as an external application under another name. The poet Anaxandrides, who flourished a short time after Hippocrates, describing the wedding of Iphicrates, who married the daughter of Cotys king of Thrace, and the Thracian entertainments given on that occasion, mentions the use of butter for food among these people as a matter of curiosity; a sure proof that it was not so employed among the Greeks. Strabo, who flourished about thirty years before the Christian era, says the Lusitanians and Ethiopians used butter instead of oil, and Ælian, who lived in the end of the first century, says that the Indians employed butter to anoint the wounds of their elephants. Plutarch, who was his cotemporary, speaks of a visit paid by a Lacedæmonian lady to Berenice the wife of Deiotarus, which according to him, seems not to have been mutually agreeable; for he says the one smelled so much of butter, and the other of perfume, that neither of them could endure the other. Dioscorides (B.C. 33.) is the first author who recommends butter as an article of diet, and says it might be melted fresh, and poured over pulse and other vegetables

instead of oil, and used in pastry. He also recommends it for medicinal purposes. But Galen, who wrote at Rome about 200 years later, is much more full on the healing virtues of butter. He is surprised that Dioscorides should have said it was made of sheep's and goat's milk, for he himself had seen it made of cow's milk; and such butter, he affirms, was always the fattest and best, and had from thence, he believes, derived its name. He says it may be used instead of oil in mollifying leather, and that in cold countries which did not produce oil, butter was used in the baths, and was evidently a real fat, because, when poured over burning coals, it readily caught fire. From all this it is evident, that butter in his time must have been very little known to the Greeks and Romans. Strabo, speaking of the ancient Britons, says, though they had abundance of milk, some of them were so ignorant that they did not know how to make a cheese. But Pliny, on the other hand, affirms, that "the barbarous nations," by which he usually means the Germans and Britons, not only made cheese, but likewise butter, which they used as a most agreeable food; and the use of this food was a distinguishing mark betwixt the rich and the poor. To these nations he ascribes the invention of butter, and says they made it from the milk of the goat, the sheep, and the cow; most commonly from the latter, but that the milk of the ewe produced the fattest butter. He likewise describes the form of the vessel employed by the barbarians in making it, which seems to have been not very different from what we now use. It was covered, he says, and had holes in the lid. He is the first Latin writer who mentions the word *butyrum*, though Vossius thinks it is to be found in Columella. Whether Tacitus by *lac concretum*, which he affirms to have been the most common food of the Germans, means cheese or butter, it is impossible to determine. The Greeks, then, seem to have derived their first acquaintance with butter from the Thracians or the Scythians, and the Romans from the Germans. Nor did either of them, after learning its nature, employ it as an article of food, but only as an ointment in their baths, and in medicine. Their agricultural writers, who treat largely of milk, cheese, and oil, as food, take no notice of butter, nor is it mentioned by Apicius. The suggestion of Dioscorides, therefore, formerly mentioned, that butter might be conveniently used in cookery, seems not to have been attended to. Fourcroy thinks, that the effect of agitation in separating butter from milk, must have been accidentally made by the Scythians or other wandering tribes while transporting their milk from place to place in skins or other vessels. Sidonius Apollinaris informs us, that the ancient Burgundians were accustomed to besmear their hair with butter; and Clemens Alexandrinus says, that the ancient Christians of Egypt burned butter in their lamps at their altars instead of oil; a practice somewhat similar to that which has been retained by the Abyssinians. In the Roman Catholic churches, it was anciently allowed, during Christmas time, to use butter instead of oil, on account of the great consumption of this in other ways. This accounts for the name "butter tower," which we find in some places, as at Rouen, Notre Dame, and others. In 1500, George d'Amboise, Archbishop of Rouen, finding the oil fail in his diocese during Lent, permitted the use of butter in their lamps, on condition that each person should pay six deniers for the indulgence, with which sum this tower was erected.

From all the accounts of the method of making butter transmitted to us by the ancients, we have reason to think that they were unacquainted with the art of giving it that firmness and consistence which is so valuable a quality of modern butter. They always speak of it as a liquid substance. With them it was

poured out like oil; with us it is cut and spread. Their butter was probably much inferior to ours, and its use very limited.

Butter has been usually thought to be a matter naturally distributed through the milk, and existing, along with the caseous and serous parts thereof, in a state of mechanical suspension, similar to that in which oil is when suspended in water by means of syrup or mucilage. But though a mixture of this sort—commonly called an *emulsion*—puts on a white colour like milk, and its oily parts by rest rise to the top and form a cream similar to the cream of milk, yet the experiments of Messrs. Deyeux and Parmentier seem to have proved, that butter does not actually *exist* in the cream, but that it is formed from it, during the process of churning, by certain chemical changes which then occur. These gentlemen were led to form this opinion, by observing that butter could not be produced in any other way than by agitation; whatever substances or means they employed to detach either the cheesy or buttery part of the cream, they always found agitation or churning necessary. Fourcroy considers the butyraceous matter of milk as quite distinct from butter; and says, it is a white liquid oil, suspended in the serum, by means of the muco-saccharine and cheesy parts, which, combining with oxygen, forms butter. The oxygen he conceives it to obtain partly from the atmosphere, and partly from the milk itself. He is of opinion, that butter in a small quantity can be obtained without agitation; and says, that the oily particles of the butyraceous matter, which, from their greater levity, float, when the milk is allowed to rest, on the surface of the caseous and serous fluid, absorb oxygen from the atmosphere, and become real butter.

That important chemical changes take place during the operation of churning, there can be no doubt; but the nature of these is still, however, imperfectly understood. Farther experiments seem necessary to elucidate the subject. In all cases, there is a considerable extrication of gas; Dr. Young affirms, that there is likewise a rise of temperature equal to four degrees; and Professor Traill found from experiment that the rise of temperature is greater than Dr. Young supposed, and ranges from five to eight degrees. In the Mid-Lothian agricultural report for 1795, it is stated, that cream churned in contact with atmospheric air, absorbed a considerable quantity of it. But Dr. Young has shown, that butter may be obtained from cream by churning, without the contact of air. These two statements, however, are not irreconcilable, since, according to Fourcroy, the butyraceous matter takes its oxygen partly from the air, and partly from the milk. That this matter should absorb oxygen, and thereby acquire the consistence of butter, is quite analogous to what happens to other oily bodies, which all become thicker by absorbing the oxygenous principle. The gas disengaged is

probably the carbonic acid gas; for every person must have observed, that when even sour cream is churned, the butter obtained is perfectly sweet; and the milk remaining in the churn, called the *butter-milk*, is always much less sour than the cream had been.

Though butter is obtained usually by agitating cream, it may be also got by agitating milk as drawn from the cow, and even in greater quantity than from the cream alone of the same milk—a fact well known to those who superintend dairies. The result of a series of experiments by Professor Traill, upon the churning of sweet cream alone, of sweet milk and cream together, of slightly soured or acidulated cream, of soured milk and cream together, and of scalded cream or “the clouted cream” of Devonshire, showed, in the first place, that the addition of some cold water during churning facilitates the process, or the separation of the butter, especially when the cream is thick and the weather hot; secondly, that cream alone is more easily churned than a mixture of cream and milk; thirdly, that butter produced from sweet cream has the finest flavour, when fresh, and appears to keep longest without acquiring rancidity,—but that the buttermilk, so obtained, is poor, and small in quantity; fourthly, that the scalding of the cream, according to the Devonshire method, yields the largest quantity of butter, which, if intended for immediate use, is agreeable to the palate and readily saleable,—but if intended to be salted, is most liable to acquire, by keeping, a rancid flavour; fifthly, that churning the milk and cream together, after they have become slightly acid, seems to be the most economical process on the whole, because it yields a large quantity of excellent butter, and the buttermilk is of a good quality—a point of some importance when buttermilk is largely used as an article of diet, as it is in Lancashire; and sixthly, that the keeping of butter in a sound state appears to depend on its being obtained as free from uncombined albumen, or caseine, and water, as it can be, by means of washing and *working* the butter when taken from the churn. Even whey, by churning, yields butter. In the agricultural report before quoted, it is stated, that 27 Scotch pints of whey, that is about 108 English, afford at an average one pound of butter. The oily part of the milk appears to have so strong an attraction for the other ingredients, that it never completely separates from them.

Butter can by no means be equally well-obtained from the milk of every sort of animal: indeed, the milk of some of them can never be made to yield any butter. No length of churning will produce it from the cream of woman's milk, or of mare's milk; while, on the contrary, the cream of goat's milk, and ewe's milk, yield it in abundance, and with as much facility as the cream of the milk of the cow. The cream of ass's milk, when long agitated, yields a soft,

white, insipid butter, which has the singular property of again mixing very readily with the butter-milk, and of being again separated from it by agitating the containing vessel under cold water.

When butter is kept for a certain time, it acquires a peculiarly disagreeable smell and taste, known by the name of rancidity. This has been thought to arise from the development of a peculiar acid, similar to, if not the same with, the sebatic acid; but Deyeux and Parmentier have shown, that no acid is present in rancid butter. Rancid oils, however, certainly do show acid properties. The disposition of butter to become rancid, is owing in a good measure to the presence of foreign matters adhering to it; for if the butter be carefully washed, so as to separate completely the serous and curdy parts, rancidity does not take place nearly so soon. When butter is distilled, we obtain a little water and sebatic acid: the greatest part of the butter comes over in the state of an oil, with a strong, pungent, and very disagreeable smell; much carburated hydrogen gas is disengaged, and there remains in the retort a very small carbonaceous residuum, with a little phosphate of lime.

The processes for making butter have been various in different ages, and among different nations. The operation of churning is well known; and we have only to observe, that though churns have been constructed of different forms, they may be all reduced to two, the vertical and horizontal. The *vertical*, or *pump-churn*, as it is usually named, was probably the first thought of, and is nothing more than a tall wooden vessel, three or four feet high, narrow in proportion to its height, and straiter above than below, having a sort of piston or staff, about four feet long, adapted to it, with a perforated head, by moving which up and down with the hands, the cream is agitated, and the butter at length formed. The utensil is sufficiently well adapted for making butter on a small scale, where the cream to be churned is the produce of a few cows only. But where dairying is managed on a great scale, and the quantity of cream large, the operation performed in this way is too tedious and laborious for general use, and methods have been contrived to expedite the process and abridge the labour. This is best done by means of the *horizontal*, commonly called the *barrel-churn*, which is a cylindrical vessel, close at both ends, and firmly fixed upon a stand, having a sort of rack or trundle adapted to it within, usually with four blades, and turned by a winch or handle, placed on its axle, passing through the ends of the churn. By this machine, as much cream may be churned in an hour as could be done in ten or twelve by the common upright churn. Ingenious machinery for working both species of churns, by means of water, and other moving powers, have been contrived, and found to answer well. The apparatus may be made of wood, iron, or sheet-tin; but the first is preferable. The

cream should not fill above two-thirds of the churn. See the article CHURN.

In the northern parts of Africa, in Egypt, and Arabia, they churn by putting the cream into a goat's skin, turned inside out, and pressing it to and fro, in a uniform manner. Sometimes they place it on an inclined plane, permitting it to roll to the bottom, and then again replacing it to run the same course,—a method which in a short time produces butter. Dr. Chandler, while travelling in Greece, observed them treading the skins thus filled with their feet; a practice which has been thought to illustrate the passage already quoted from the book of Job. In Bengal, they churn by simply turning a stick in the milk; and that families may have the butter fresh and sweet to breakfast, it is made in this way every morning. In many parts of the East, they make butter of the milk of the buffalo; but this is by no means esteemed equal in excellence to the butter of the cow's milk. It is deficient in consistence, colour, and flavour.

With regard to the good or bad qualities of butter, a great deal has been always ascribed to the pasturage of different farms or districts. Recent observations and experiments, however, show that much less depends upon this than has been commonly imagined. The mode of management appears to be of much greater consequence. "In every district," says Dr. Anderson, "where fine butter is made, it is universally attributed to the richness of the pastures, though it is a well known fact, that take a skilful dairy-maid from that district into another, where no good butter is usually made, and where, of course, the pastures are deemed very unfavourable, she will make butter as good as she used to do; and bring one from this last district into the other, and she will find that she cannot make better butter there than she did before, unless she takes lessons from the servants or others whom she finds there."—"I have frequently," continues he, "known instances of this kind. And the same thing takes place in the manufacture of beer and many other articles. In matters of this sort, a very great diversity is produced by circumstances apparently of a most trivial kind." M. Tessier, of the National Institute of France, says, "The particular nature of Bretagne butter, whose colour, flavour, and consistence, are so much prized, depends neither on the pasture nor the particular species of cow, but on the mode of making. This butter is of a superior quality, because they make it of the richest cream, and usually in large quantities at a time. As soon as it is made and washed, they sprinkle it with sweet milk, spread it out in flatted cakes, larger or smaller, but rarely containing less than three, or more than six pounds; and lay it on a kind of pan, placed on hot cinders, and covered with a copper lid, on which are put cinders also. It remains there some minutes, more or fewer according to the bulk of the cake." This mode of managing but-

ter appears from him to be a secret in certain families, and to require practice and dexterity to conduct it with success.

Still, however, we are disposed to believe that some pastures are more favourable to the production of good butter than others. Certain plants, such as turnip, wild garlic, hemlock, rough-leaved dandelion, charlock, the butter-cup, and may-weed, are known to affect milk with a disagreeable flavour, and there may be many others which, to a certain degree, impair its goodness, though their effects are by no means so evident. Far more, however, depends on good management than on this circumstance, or even on the species of cow we feed; for that something, likewise, is owing to this, is equally well ascertained. Cows have been found whose milk could not be brought to yield any butter at all. It has been long remarked, that the butter in the Highlands of Scotland, when properly made, possesses a peculiarly rich and delicate flavour; and this has been almost universally attributed to the old grass on which the cows feed in these remote glens. But what more common error than to mistake a concomitant circumstance for a cause? Dr. Anderson, by his experiments on milk, has shown that the excellence of the Highland butter may be very reasonably ascribed to a quite different cause. He has proved that the cream of a given measure of milk constantly increases in quantity, and still more in quality, from the first drawn tea-cupful, to the last drop that can be squeezed from the udder at the time. "Probably," says he, "on an average of a great many cows, the proportion of the cream obtained from a given quantity of the last drawn milk, may be to that of the cream obtained from an equal quantity of the first drawn, as ten or twelve to one; but the quality of the cream of the last drawn was still more superior than its quantity. The cream of the first drawn tea-cupful of the milk was only a thin white film; in the last, it was of a thick butyraceous consistence, and of a glowing richness of colour, such as no other cream possesses. It is, therefore, observes Dr. Anderson, of much more importance than is commonly imagined, to milk the cows well; for on the cream of the last drawn milk depends entirely the richness and delicate flavour of the butter." Now, in the Highlands of Scotland, where they rear almost all their calves, the common practice is to admit the calf to suck the mother always for a certain time before milking. And when the dairy-maid judges the calf has had enough, it is removed to the pen or *cruive*, from which it had been brought. In this way, the latter drawn parts of the milk only are obtained for the dairy; and the cream produced from it being of a superior quality, the excellence of the Highland butter seems to be accounted for. In the higher districts of Gallo-way, a similar mode of management prevails, and their butter is observed to be rich and delicate.

It has been likewise ascertained, that the cream which first rises after the milk has been deposited in the dairy-pans, is both much greater in a given space of time, than that which rises in an equal space several hours after, and of a greatly superior quality; that thick milk throws up less cream than thin, but of a richer quality; and that milk that has been much agitated by carrying, and cooled before it is put into the milk-pans, never throws up so much cream as that which is immediately deposited in them after milking. It is also known, that the milk is not at the best till about four months after the cow has calved; and that the degree of heat most favourable to the production of cream from milk, is from 50 to 55 degrees of Fahrenheit's thermometer. "If the heat of the milk-house," says Dr. Anderson, "be too great, the milk suddenly coagulates, without admitting of any separation of the cream; or it is so quickly turned sour, as greatly to mar the operation. If, on the other hand, the milk be exposed to too cold a temperature, the cream separates from it slowly, and with difficulty; it acquires a bitter and disagreeable taste; the butter can scarcely be made to come at all; and when it is come, it is so pale in the colour, so small in quantity, and of such hard and brittle consistence, so poor to the taste, and of so little value in all respects, as to bring a very low price at the market, compared to what it would have produced had it been preserved in a proper degree of heat." The same judicious writer states it as his opinion, formed from experience and attentive observation, that since neither cream nor butter can be produced from milk till some portion of an acid be evolved in it, the last drawn half of the milk only should, in general, be set up for producing cream, and be allowed to stand till it throw up the whole of its cream, even till the milk tastes perceptibly sourish; and that if this cream be afterwards judiciously managed, the butter thus obtained will be of a greatly superior quality to what can be usually got at market, and its quantity not considerably less than if the whole of the milk had been originally set apart for producing cream. "This, therefore," says he, "is the practice that I should recommend, as most likely to suit the frugal farmer; as his butter, though of a superior quality, could be afforded at a price that would always insure it a rapid sale."

The degree of heat during the process of churning has a far more powerful influence on both the quantity and the quality of the butter than is commonly supposed. In the portion of the Highland Society's Transactions published in November 1828, appears a report of five experiments by Dr. John Barclay and Mr. Alexander Allen, as to the temperature at which butter can be best procured from cream. The following table exhibits the mean temperature of the cream used in each experiment, the time occupied in the different churnings, the quantity of butter

obtained from one gallon of cream in each experiment, the gravity of one gallon of the churned milk produced in each process, and the comparative qualities of the different specimens of butter:—

No.	Date of experiments.	No. of Galls.	Mean Temp.	Time occupied in churning.		Quantity of Butter obtained.			Quantity of the churned milk.	
				H.	M.	lb.	oz.	dwt.	lb.	oz.
1	Aug. 13.	15	55°	4	0	1	15	7.5	8	9
2	..... 26.	15	60°	3	15	1	15	3.2	8	8
3	..... 30.	15	62°	3	0	1	14	0	8	8
4	Sept. 4.	15	64°	3	1	1	12	12.7	8	8
5	..... 9.	15	70°	2	30	1	10	10.6	8	7

The butter produced in the first experiment was of the very best quality, rich, firm, and well tasted; that produced in the second experiment was not perceptibly inferior to the former; that produced in the third experiment was good, but of an inferior consistency; that produced in the fourth experiment was soft and spongy; and that produced in the fifth experiment was decidedly inferior in every respect to any of the former specimens.

"From the preceding experiments," say the reporters, "it appears that cream should not be kept at a high temperature in the process of churning. In the first experiment, when the temperature was lowest, the quantity of butter obtained was in the greatest proportion to the quantity of cream used; and as the temperature was raised, the proportional quantity of butter diminished;—while, in the last experiment, when the mean temperature of the cream had been raised to 70°, not only was the quantity of butter diminished, but, in quality, it was found to be very inferior, both with regard to taste and appearance. That the lowest possible temperature should be sought in churning, appears likewise from another result of the preceding experiments—the specific gravity of the churned milk having been found to diminish as the temperature of the cream had been increased; thus showing, that, at the lower temperatures, the butter, which is composed of the lighter parts of the cream, is more completely collected than at the higher temperatures, in which the churned milk is of greater specific gravity. From these experiments, the subscribers conceive themselves warranted in concluding, that the most proper temperature at which to commence the operation of churning butter, is from 50° to 55°; and that at no time in the operation ought it to exceed 65°: while, on the contrary, if at any time the cream should be under 50° in temperature, the labour will be much increased, without any proportionate advantage being obtained; and a temperature of a higher rate than 65° will be injurious as well to the quantity as the quality of the butter."

The present professor of chemistry in Glasgow, Dr. Thomas Thomson, instituted a series of experiments last year into the relative effect of different elements on the milk and butter of cows, which we shall here note. "We procured," says Dr. T. and his assistant, "two young cows from Ayrshire, of the best breed of milk-

cows in Scotland. They were selected by Mr. Tennant, a large farmer at Shields, near Ayr. They had calved about six weeks before we got them, and they were supposed to be in calf again. One of these was brown, and the other brown mixed with a good deal of white; on that account they are distinguished by the names of *brown cow* and *white cow*. Our object in getting two cows was to feed the one with barley and the other with malt, and observe what effect the food would have upon the milk and butter of each. But it became soon evident that the constitution of the two cows was so different that no fair conclusion could be come to by that mode of proceeding. We were obliged, in consequence, to give the same food to each, and to draw our consequences from the effects produced upon both. At first we gave the cows the barley and the malt entire, after they had been steeped for some time in hot water; but we soon found that it was better to grind them into meal, and to digest the meal in hot water. The result of the experiments is placed under the form of the following table:—

	BROWN Cow.		WHITE Cow.	
	Milk.	Butter.	Milk.	Butter.
	lbs.	lbs.	lbs.	lbs.
I. Grass	26.604	0.735	21.868	0.516
II. Barley	20.420	0.7075	20.108	0.555
III. Malt	19.341	0.6332	20.417	0.6749
IV. Barley	22.610	—	22.000	0.790
V. Barley	23.187	0.791	21.763	0.678
VI. Molasses	20.558	0.730	22.703	0.654
VII. Malt	19.710	0.682	21.585	0.591
VIII. Barley	19.396	0.675	20.088	0.565
IX. Linseed	20.280	0.734	20.244	0.741
X. Linseed	20.814	0.687	20.814	0.682
XI. Bean-meal	19.590	0.755	19.582	0.755

"These experiments," Dr. T. continues, "leave no doubt that barley is more nourishing to cows than malt; at least so far as the production of milk and butter is concerned. They confirm the conclusions which we drew from the chemical analyses of both. Barley, when malted, loses almost one-fifth of its weight. The proportion of azote which is necessary both for the support of animal life and for the production of milk is considerably less in malt than in barley." * * "Previous to these trials, thus arranged, the largest quantity given to the brown cow was under the grass regimen. The first five days of the experiment yielded 4.93 lbs. of butter, after which the quantity diminished to the last five days of the trial, when the quantity yielded amounted to 3.75 lbs., a proportion not superior to what was produced in some of the subsequent experiments. The same law does not appear to hold with reference to the diminution of the butter as pertains to that of the milk, when the food has been continued for some time. We find, on the contrary, frequently the amount increasing towards the close of the experiment, even when it is continued for ten or fifteen days. The largest amount of butter was afforded in the brown cow by crushed barley. During the third

series of five days the amount was 3·935 lbs.; bean-meal gave the next greatest quantity, 3·69 lbs. in five days; then comes barley and linseed, 3·689 lbs. during the first five days; barley and molasses, 3·63 lbs.; and malt, 3·60 lbs. In the case of the white cow the quantity was—beans, 3·76; barley and linseed, 3·421; crushed barley, 3·376; barley and molasses, 3·26; and malt, 3·126. With both animals we observe that malt is lowest in the scale, a fact which seems in some measure to militate against the idea of the origin of the butter being in the sugar of the food. Be this as it may, however, although there are many counter arguments in favour of the opinion that sugar affords such a supply, we think the tables Nos. 1 and 2 tend to show that there is no relation between the butter of the milk and the wax and oil of the food, since frequently, when the oleaginous matter of the food is small, the butter is more considerable than on other occasions when the reverse happens. Since then the facts contained in the tables seem to prove that the butter cannot be supplied from the oil of the food, it becomes an interesting point for the agriculturist to learn from what element of the food it proceeds. It may safely be inferred that it must be formed from some other constituent of the diet by means of the vascular system, either as a primary or secondary stage. Sugar affords the most simple element from which it may be produced, because we now understand how the acid of butter can originate from sugar; but even the albuminous principles might afford butter. Upon these grounds, then, we can infer that a certain degree of exercise would be more conducive to the production of fat than if the animal is allowed to remain at rest; because, as the source of the fat or butter is dependent on the process of respiration, it is obvious that the more the function is encouraged within moderate bounds the greater the amount of oil-giving principle of the food will be taken into the system and converted into fat. We believe that this theoretical deduction is perfectly in consonance with the experience of good observers, who find that box or hammel feeding is more conducive to health of cattle and cows destined for the butcher, or for the production of butter, than close plant-like confinement, which is foreign to the nature of every animal, and at variance with the first principles of physiological science."

Cows, in summer, should be milked three times a-day at least; early in the morning, at noon, and just before night-fall. If this be not done, the greatest possible quantity of milk will be far from being obtained from them. The milk is secreted in the udder, very much in proportion to the quantity required, as we see in the case of dogs, cats, pigs, and other animals, which produce more young than one at a time; and we know that a cow, by scanty milking, can very soon be put dry. It is therefore of the utmost consequence, that the whole milk secreted be at

each milking carefully drawn away. The cows should be as little driven as possible before milking; and their teats should be washed clean with water, applied by a bit of sponge, before the process commences. It may be laid down as a pretty general rule, that 18 pounds of milk will yield one pound of butter; and that this is the produce of a single cow per day during summer, and half that quantity in winter. Some, however, will furnish twice, or even thrice this quantity. The effects of feeding, treatment, management, and the idiosyncrasy of particular animals, are here astonishingly great. See the article Cow.

When brought into the dairy, the milk should be strained through a fine sieve and then poured into pans or troughs about 4 inches deep. From 12 to 20 hours in summer, and about twice as long in winter, should be permitted to elapse before the milk is skimmed, after it has been put into the milk-pans. If, on applying the tip of the finger to the surface, nothing adheres to it, the cream may be properly taken off; and during the hot summer months, this should always be done in the morning, before the dairy becomes warm. The cream should then be deposited in a deep pan, placed in the coolest part of the dairy; or in a cool cellar, where free air is admitted. It is customary to stir the cream frequently with the view of encouraging a slight degree of acidity, which is deemed necessary to the production of butter; but it is well-known that excellent butter can be produced from perfectly fresh cream.

In hot weather, churning should be performed, if possible, every other day; but if this is not convenient, the cream should be daily shifted into a clean pan; and the churning should never be less frequent than twice a-week. This work should be performed in the coolest time of the day, and in the coolest part of the house, where there is a free draught of air. Cold water should be applied to the churn, first by filling it with this, some time before the cream is poured in, and then by immersing it in water to the depth of a foot or so, during the operation, provided we use the pump-churn; or by applying wet cloths to it, if we use a barrel-churn. Such means are generally necessary to prevent the too rapid acidification of the cream, and formation of the butter. The winter season and cold weather, of course, require an opposite practice; but we can hardly be too cautious in the application of heat; for the common practices of wrapping the churn in a warm cloth, plunging it into hot water, adding warm milk to the cream, or placing the churn near the fire, all tend to injure the butter. The best way, perhaps, is to heat the churn, by filling it with boiling water before the cream is put in, and to place it in the warmest part of the house; but not close by a fire. The temperature should be as near 55° as practicable, and ought not to exceed 60°.

The operation of churning ought to be moder-

ate, equable, and uninterrupted; for if we stop or relax in our exertions, the butter will *go back*, as it is called; and if the motion be too quick and violent, the butter will be soft and of a white colour, besides imbibing a very disagreeable flavour. This, in some districts of Scotland, is known by the phrase *bursting* the churn. Machinery, as before observed, of an ingenious and convenient construction, is in some districts now employed, and found to have the advantage, not only of abridging labour, but of securing a more regular and uniform motion.

When the operation is properly conducted, the butter, after some time, suddenly forms, and is to be carefully collected and separated from the buttermilk. But in doing this, it is not sufficient merely to pour off this milk, or withdraw the butter from it; because a certain portion of the caseous and serous parts of the milk still remain in the interstices of the butter, and must be detached from it by washing, if we would obtain it pure. In washing butter, some think it sufficient to press the mass gently betwixt the hands; others press it strongly and frequently, repeating the washings till the water come off quite clear. The first method is preferable when the butter is made daily for immediate use, from new milk or cream; because the portions of such adhering to it, or mixed with it, contribute to produce the sweet agreeable flavour which distinguishes new cream. But when our object is to prepare butter for keeping, we cannot repeat the washings too often, since the presence of a small quantity of milk in it, will, in less than twelve hours after churning, cause it sensibly to lose its good qualities. When the butter is very soft, especially in hot weather, it should be allowed to lie during ten or twelve minutes in the cold water, to acquire better consistency before being washed. The process of washing butter is usually nothing more than throwing it into an earthen vessel of clear cool water, working it to and fro with the hands, and changing the water till it come off clear. A much preferable method, however, and that which we believe is now always practised by those who best understand the business, is, to use two broad pieces of wood instead of the hands. This is to be preferred, not only on account of its apparently greater cleanliness, but also because it is of decided advantage to the quality of the butter. To this the warmth of the hand gives always more or less of a greasy appearance; and butter washed by means of the wooden *flappers*, as they are called, will always fetch at market a higher price than if the hand had been employed. The influence of the heat of the hand is greater than might at first have been suspected. It has always been remarked, that a person who has naturally a warm hand, never makes good butter.

After washing, the butter should be cut and sliced in every possible direction, with a serrated or rough-edged knife, in order to bring out from

it the smallest hair, bit of rag, strainer, or anything that may have chanced to fall into it. It is then to be spread in a bowl, and such a quantity of salt added as may be judged proper. If the butter is to be used immediately, or kept only for a short time, a small proportion will be sufficient; and in this state it is usually denominated *fresh* butter. But if it be intended to be long kept, or transported to a distance, an ounce or two of salt will be required to the pound of butter. The salt used in curing butter should be of the purest kind, well dried, and broken down, but not completely pulverized; and it must be so thoroughly worked in, as to be equally incorporated with the mass. See the article DAIRY.

When butter is to be sold on the spot, or in the neighbouring markets, it is divided into rolls of a pound, or half a pound; or into lumps of 24 ounces, called dishes in some parts of England; but when it is to be kept, or carried to a distance, quantities of 84, 56, or 28 pounds, are put up together in casks, usually called tubs, firkins, and half-firkins.

When the butter has been sufficiently impregnated with the salt, by being spread out in thin layers, sprinkled with it, and thoroughly wrought, it is then to be gently pressed into the tub or firkin, which must not, however, be filled quite up, but room left at top to receive a layer of salt, half an inch or an inch in thickness. In seven or eight days, the salted butter detaches itself from the sides of the firkin, shrinks, and occasions interstices. These, if allowed to remain, would injure the butter, by admitting the contact of the air. They are, therefore, to be filled up by a saturated solution of salt in water, or brine strong enough to carry an egg. The butter is then to be covered by a new layer of salt, and the head of the vessel put on. Before the butter is put into the firkin, care must be taken that the latter—which, if new, should be of clean white wood, and carefully washed inside with hot brine—be well seasoned: and this is effected by exposing it for two or three weeks to the air, and frequent washing. The readiest method, however, is by the use of unslaked lime, or a large quantity of salt and water well boiled, with which it should be scrubbed several times, and afterwards thrown into cold water, to remain three or four days till wanted. It should then be scrubbed as before, and well rinsed with cold water; and before receiving the butter, every part of the inside of the firkin must be carefully rubbed with salt. Indeed, the surest of all methods to preserve butter from spoiling, after it has been properly salted, is to keep it constantly immersed in a saturated solution of this substance. An excellent composition for preserving butter may be prepared, by mixing one part of saltpetre, one of common salt, and two of sugar. This thoroughly wrought into the butter, will keep it sweet for a very long time, and com-

municates to it no salt or disagreeable taste. Some use a mixture of half-an-ounce of dry salt finely pounded, 2 drams of sugar, and 2 drams of saltpetre, for every pound of butter.

Almost every kind of wood hitherto used for making butter-casks communicates a woody flavour to butter, and, conjointly with the salt, even exerts so great a chemical power upon it as to occasion some of it to melt and drain off in the form of brine. The best oak and ash have been much recommended, but they too have bad properties. But, says Mr. George Moir, in a published communication to the Highland Society, "The lime is pre-eminently suited for the manufacture of butter-casks. It is the only wood *free of acid*,—a point which I have ascertained by innumerable experiments. In the manufacture of basket-salt, the splits for the baskets were at first made of ash, from the circumstance of that species of wood being particularly straight in the grain. I found, however, that the acid in the ash decomposed the salt. I then made trial of every kind of wood I could come at, and found none but the lime to be free of acid. Next in order was the fir. The acid acts most powerfully on salt, decomposes it, and makes it run into a liquid, which I have proved by a hundred experiments. In one instance I got a tree of poplar, white as writing-paper, and made it into baskets. I filled fifty dozen of them with salt; when they were in the stove I anticipated perfection itself, but to my great surprise and disappointment, on being exposed to the air for half an hour, they became all covered with spots red as blood. When again put into the stove for some time, the spots disappeared, but when exposed to the air for two or three days, the wood became as dark as mahogany, and retained that colour. Nor was this all; every one of the fifty dozen of baskets became quite empty by decomposition, and many of them after having been twelve months in the stove. This induced me to endeavour if possible to extract the acid from all kinds of wood before using it. The following is the plan which I have adopted. Cut the wood into deals of the lengths required; have a boiler of a square form, the length of the wood, full of water: put in the wood with a weight or pressure, to keep it immersed in the water, and have a wooden cover on the boiler, as it must be done by close evaporation. When thus boiled for *four hours*, the whole of the pyrolignous acid will be extracted. The wood is then dried for use. It becomes closer and more condensed, from the fibres being contracted. By this method, while the wood continues hot, it can easily be brought to any shape, and used for various purposes, and this is the only mode by which barrels for salted butter should be made."

When butter is to be exposed to the heat of a warm climate, it should be purified by melting, before it is salted and packed up. Let it be put

into a proper vessel, and this into another containing water; let the water be gradually heated till the butter be thoroughly melted; let it continue in this state for some time, and the impure parts will subside, leaving at the top a perfectly pure transparent oil. This, when it cools, will become opaque, and assume a colour nearly resembling the original butter; being only a little paler, and of a firmer consistence. This refined butter must be separated from the dregs, salted, and put up in the same way with other butter; and it will keep much longer sweet in hot climates, as it retains the salt better. It may also be preserved sweet, without salt, by adding to it a certain proportion of fine honey, and mixing them thoroughly, so that they may be perfectly incorporated. A mixture of this sort has a sweet pleasant taste, and will keep for years without becoming rancid. It might of course be very useful in long voyages. Dr. Anderson thinks an ounce of honey sufficient to preserve a pound of butter.

To preserve butter for a long time fresh without any foreign mixture, the best method perhaps is, first of all to wash the buttermilk completely out, and then to keep the butter under pure cool water, frequently renewed. Some wrap it up in a wet linen cloth, to defend it from the influence of the air. But though fresh butter be kept cool and from the air, it will in no very long time become rancid. We cannot by any means keep it fresh from one year to another, or transport it to a distance in good condition. Rancid butter, to most people, is extremely disagreeable. A very small quantity of it will be observed by many in a large mass of meat, that it may be employed to season. Few stomachs can digest rancid butter. Some are so delicate, that the use even of fresh butter, of milk, of cream, and in general of all oleaginous substance, affect them with difficult and painful digestion.

Butter, to be a wholesome aliment, must be free from rancidity, and not fried or burned. But even in its purest state, there are few who can indulge very freely in the use of this article with impunity; and health, perhaps, would not suffer, though its employment as food were altogether laid aside. Like the other bland oils, it is gently laxative. Most housewives know several receipts for restoring rancid butter to freshness. But of these the greater number are of little use. Washing it well with pure water, or with ardent spirit, still better perhaps with sweet milk, will deprive it in some measure of its disagreeable smell and taste. It is of much more consequence to preserve butter from becoming rancid, by salting, and the other means already explained.

As turnip is now become so common a food for cows, and often imparts to their milk, and the butter thence made, a very disagreeable flavour, it is of some consequence to know how this

may be best obviated. A small quantity of saltpetre has been recommended; and in the 'Georgical Essays,' vol. v. we have the following method: "Let the bowls or pans be kept constantly clean, and well scalded with boiling water before using.* When the milk is brought into the dairy, to every eight quarts mix one quart of boiling water; then put up the milk into the bowls to stand for cream." Dr. Anderson says, "that if the milk is to be used sweet, its taste may be considerably diminished by boiling; and that other means of sweetening milk have been attempted, more troublesome and expensive, and not more efficacious." A disagreeable taste in either milk or butter may not unfrequently be removed by giving the cow in which it is observed a dose of half-an-ounce of nitre, which is always a safe and cooling medicine.

As butter made in winter is generally pale or white, and its richness at the same time inferior to that which is made during the summer-months, the idea of excellence has been associated with the yellow colour. Means are therefore employed by those who prepare and sell butter, to impart to it the yellow colour where that is naturally wanting. Various substances have been used for this purpose, but they must all be of the resinous class, or such as are soluble in oils. Extractive matters, and such as are soluble only in water, alcohol, &c., as beet-root and cochineal, give no tinge to butter. The substances most commonly employed are the root of the carrot, and the flowers of the marigold. The juice of either of these is expressed and passed through a linen cloth. A small quantity of it, (and the proportion necessary is soon learned from experience,) is diluted with a little cream, and this mixture is added to the rest of the cream when it enters the churn. So little of this colouring matter unites with the butter, that it never communicates to it any peculiar taste. Many other colouring matters have been employed, as saffron, the seed of the asparagus; but the marigold and carrot are certainly the best, and it is the latter that is chiefly used by the best farmers. Alkanet root will give every shade of colour to butter, from the lightest rose to the deepest red, by augmenting or diminishing the proportions of it.

Though the milk of the cow, when fed on rich pasture during the summer months, is almost always found to produce butter of a rich yellow colour, this is by no means the case with every animal. The goat, the sheep, the mare, and the ass, fed on the same pasture in the same season,

produce milk which yields butter always more or less white. When a cow has recently calved, her milk is much yellower than usual, but this soon goes off.

Some counties or districts are particularly famous for the excellency of their butter. That which is made in Essex, and well known under the name of *Epping butter*, is the most highly esteemed of any in London and its vicinity. In the more restricted use of this appellation, it is applied only to the butter made from the milk of cows which are fed in Epping forest during the summer months, where the leaves and some particular plants are thought to contribute to its superior flavour. In Somerset butter of nearly the same excellency is made; but brought to market in half pounds instead of pounds. The Cambridgeshire salt-butter is held in the highest esteem; and the London cheesemongers, by washing and detaching the salt from it, often sell it at a high price for fresh butter. It is made nearly in the same way as the Epping butter, and when salted, put up in firkins of 56 pounds. Yorkshire and Suffolk butter is very little inferior to that of Cambridgeshire, and is often sold in London for such. Uttoxeter, in Staffordshire, has long been famous for good butter. The London cheesemongers have a sort of factory there for this article. It is bought by the pot, of a cylindrical form, weighing 14 pounds. The superior excellence of the butter produced in the Highland districts of Scotland, has been already remarked, and we hope accounted for. The same delicately flavoured species is said to be made on the mountains of Wales, and the heaths and commons of England. Some of the best Irish butter brought to London, after being washed and repacked, is sold as Dorsetshire and Cambridgeshire butter. The salt butter of Holland is superior to that of any other country; and forms about three-fourths of all the foreign butter imported into Britain.

Frauds and abuses of various kinds are practised in the salting and packing of butter, to increase its bulk and weight. Pots are frequently laid with good butter for a little way at the top, and with bad at the bottom. Sometimes the butter is placed in upright rolls, touching one another above, so as to form a uniform surface, but receding so as to leave empty spaces below. Sometimes tallow or hog-lard is found to constitute no small proportion of what the purchaser had deemed good butter.

An act of parliament (36th Geo. III. c. 86.) particularly regulates the packing, salting, and selling of butter. By that statute it is enacted, that every vessel made for the packing of butter, shall be of good well-seasoned wood, marked with the maker's name, and, by a subsequent act, his place of abode; that it shall be a tub containing 84 pounds, a firkin containing 56, or a half-firkin containing 28 pounds avoirdupois, and no other; that it shall be of a particular weight, and neither

* It can hardly be necessary to observe, that the utmost attention to cleanliness, with respect to every vessel and instrument used, and every operation performed in the making of butter, is indispensably requisite. Any neglect of this kind is fatal to its goodness. It is quite necessary that the bowls or pans, after scalding, be allowed to cool before the milk is put into them.

top nor bottom exceeding a certain thickness, having the true weight or tare of the vessel, distinctly marked upon it; with a variety of other regulations to prevent frauds, under severe penalties. Any fraud with regard to the butter, the vessel, or its marks, subjects the person concerned to a forfeiture of £30 for every such offence. See articles CHURNING, COW, DAIRY, MILK.—*Fourcroy, Système des Connoissances Chimiques*, tom. ix.—*Deyeux and Parmentier, Mémoire sur le lait*.—*Thomson's Chemistry*.—*Anderson's Agricultural Recreations*, vol. iii. and iv.—*Anderson's Essays on Agriculture*.—*Mid Lothian Report*, 1795.—*Aiton's Treatise on Dairy Husbandry*.—*Quarterly Journal of Agriculture*.—*Transactions of the Highland Society*.

BUTTER-BUR. Two species of plants, of the *tussilago* or coltsfoot genus. The common butter-bur, *Tussilago petasites*, grows naturally in moist meadows and other moist situations in Britain. It has both singular habits and a remarkable appearance. Its root is perennial, white, long, thick, fleshy, and decurrent; its flower-stems are whitish, round, thick, and about eight inches in height, and have a few scaly fibres in lieu of leaves; an oval spike of flesh-coloured flowers grows on the top of each stem, and blooms in March and April; and the leaves rise after the flowers have perished, stand singly upon white, purple or greenish, hollowed footstalks,—are sometimes so enormously large as to measure three feet in breadth,—have a roundish form, cut into angles on their edges, and indented into a cordate shape at the footstalks,—and are dark green on their upper surface, and whitish and somewhat downy underneath. “The roots,” says Miller, “have a dark-coloured skin, but are white within, and have a strong scent, with a hot biting taste. They are sudorific, alexipharmic, and good for all kinds of fevers, and malignant, infectious, and pestilential distempers. They are cordial, preventing fainting and shortness of breath. A good quantity of them is put into the treacle water.” But though these mighty properties were once so generally credited as to win for the plant the popular name of pestilent-wort, they are now believed to be altogether fictitious. A hybrid variety of the common species, *T. p. hybrida*, grows naturally in the same kinds of situations as the normal plant, and has usually a height of about 18 inches. When either the normal plant or the variety infests a meadow or moist pasture, it is both a mischievous and a very stubborn weed. The white butter-bur, *Tussilago alba*, was introduced to Britain from continental Europe towards the close of the 17th century. It is rather a pretty plant, of about a foot in height, and produces white flowers in middle-winter and early spring.

BUTTER-CUP,—botanically *Ranunculus bulbosus*. A perennial, tuberous-rooted weed, of the crowfoot genus. It is also popularly called crow-toe, butter-flower, and upright meadow crowfoot.

It abounds in the meadows and pastures of Great Britain, produces a beautiful shining yellow flower in May and June, and is almost as common and as well known as the meadow daisy. Its stem is ramified and usually about a foot high; and its flowers are produced at the ends of the branches. The whole plant is exceedingly acrid, yet loses its acridity by drying. Sheep and goats eat it; but horses, cows, and swine refuse it. Bees are very fond of its flowers.—A double-flowered variety, *R. b. flore pleno*, has long been cultivated in gardens as an ornamental plant. Its stem, like that of the normal plant, is erect, ramose, and about a foot in height; its lower leaves have very long footstalks, and are divided into several segments resembling those of monkshood; its upper leaves are cut to the base into linear segments; and its flowers come out in May, and, if in a shady situation, will bloom for about a month. This plant loves moisture and shade, and is propagated by dividing the roots.—Another ornamental variety, *R. b. bracteatus*, was introduced to Britain from the Pyrenees.

BUTTERFLY. The most conspicuous and beautiful of the three great divisions of the lepidopterous order of insects. Linnæus divided the lepidoptera into the three groups of butterflies, sphinx-moths, and true moths, or *papilio*, *sphinx*, and *phalæna*; and Latreille adopted his groups, and gave them the new and expressive names of respectively *diurna* or day-fliers, *crepuscularia* or twilight-fliers, and *nocturna* or night-fliers. The *diurna* or butterflies are distinguished from the other two groups, not only by their day-flying habits, but generally by the beauty and brilliance of their colours, and always by certain peculiarities in their conformation, and especially by the particular structure of their antennæ. In all butterflies, the antennæ are nearly uniform in their general shape, slender at the base and middle, and expanding at the tip into a distinct knob or club; while in moths, the antennæ are incalculably varied in form and structure, and always diminish in size from the base to the tip.

Butterflies are divided by Latreille and most modern entomologists into the five families of papilionidæ, nymphalidæ, heliconiidæ, lyœnidæ, and hesperiidæ. The papilionidæ comprise the genera *papilio*, *zelima*, *parnassius*, *thais*, *peris*, *pontia*, and *colias*; and they have the antennæ not hooked at the tip, the anterior legs not abbreviated, but for walking, and alike in both sexes, and the pupa angulated, suspended, and braced across the middle. The nymphalidæ comprise the genera *cethosia*, *argynnis*, *melitæa*, *vanessa*, *libythea*, *biblis*, *nymphalis*, and some others; and have the middle cell of their lower wings closed, their anterior legs abbreviated and not fitted for walking, their unguis bifid, and their pupa angulated and merely suspended by the tail. The heliconiidæ comprise the genera

heliconia, danaia, acraea, and some others; and have their discoidal cell sometimes open, their anterior legs imperfect, and their pupa smooth and suspended only by the tail. The lycænidæ comprise the genera lycæna, polyommatus, thecla, and some others; and have their claws minute, their anterior legs semi-abbreviated, their larva onisciform, and their pupa smooth and braced. The hesperiidæ comprise the genera hysperia, thymele, and some others; and have their antennæ hooked at the tips, their anterior legs not abbreviated, and their pupa smooth, braced, and folliculated. Any attempt at detailed description of so very numerous a group of insects, would obviously be absurd in such a work as ours; and we shall, therefore, do no more than, first, make brief general mention of a few of the most conspicuous British species, and next, take a rather closer view of several which inflict serious damage on vegetation.

The common cabbage butterfly, *Pontia brassicae*, is the chief of several species which are well known for the ravages of their larvæ in the kitchen garden; and two broods of it are produced every year, the one in spring and the other in autumn.—The small white garden butterfly, *Pontia rapæ*, is smaller than the preceding, but otherwise very like it; and is often associated with it in devastations upon garden plants of the brassica genus.—The green-veined white butterfly, *Pontia napi*, is also very common in gardens, and appears first in May, and afterwards in July.—The hawthorn butterfly, or black-veined white butterfly, *Pieris crataegi*, appears pretty early in spring, and lays its eggs on the shoots of the hawthorn, on the leaves and twigs of the apple-tree, and on the young parts of other arborescent plants, principally of the rosaceous tribe.—The meadow-brown butterfly, *Hipparchia janira*, appears about the beginning of June, and is probably the most abundant of the British species, excepting the common cabbage kind.—The large heath butterfly, *Hipparchia tithonus*, is very abundant in most parts of England, and not unfrequent in the south of Scotland. These six species are the principal which inflict serious damage upon the cultivated plants of Great Britain.

The orange-tip butterfly, *Pontia cardamines*, is somewhat common in Great Britain; and it usually appears about the end of May, and frequents the borders of woods, and the hedges of districts which abound in trees. The male of it is very dissimilar from the female.—The brimstone butterfly, *Gonopteryx rhamni*, may be seen among hedges and coppices so early as on a sunny day of March, becomes more common as spring advances, and reappears, in a second brood, in August. The male is of a pure sulphur-yellow colour above; the female is greenish-yellow above, and somewhat paler below; and both sexes have, in the centre of each wing, a spot of orange.—The pale-clouded yellow butterfly, *Colias hyale*, is rare, and occurs principally in the

sea-board districts of Kent, Sussex, and Suffolk. The male is generally of a rich sulphur-yellow, and the female nearly white. The under wings have, in their centre, a large orange spot; and the upper wings have, near their centre, a black spot,—and, at their extremity, a deep black border, almost divided into two by a series of yellow spots.—The swallow-tail butterfly, *Papilio machaon*, is the largest of the British species, and abounds in Egypt, Syria, and several parts of the south of Europe; yet it occurs not at all in Scotland, very rarely in the north of England, and somewhat scantily in even the south of England. It is never seen on the wing with us before the beginning of June. Its expanse of wing is, in some instances, so great as $3\frac{1}{2}$ inches; its strength of flight is great; and the general colour of its wings is black, powdered with yellow, and diversified by bold markings of yellow.—The high-flier or purple emperor, *Apatura iris*, is a splendid butterfly, but occurs only in the oak-woods of the south of England, and seldom appears before the month of July. It flies with rapidity, soars over the tallest oaks, and sits down for repose upon the topmost boughs. Its wings above are dark brown, relieved by marks of white, and changing, in certain lights, into tinges of metallic purplish-blue; and the hinder wings have, near their inner angle, a small black spot surrounded with red. Its caterpillar feeds on the oak, the ash, and the willow.—The wall butterfly or orange argus, *Hipparchia megæra*, is extensively diffused, and not infrequent, and appears from May till August. Its upper wings are dark orange-yellow, marbled along the edges with dark brown, and have near the outer angle an ocellated spot of white with a black ring; and its lower wings have near their margin a curved row of spots, and are banded on the edge with brown.—The great tortoise-shell butterfly, *Vanessa polychloros*, is common in the south of Europe and other parts of the continent, but appears only in the southern districts of England, and seldom before the middle of July. Its wings are angulated, and frequently have an expanse of $2\frac{1}{2}$ inches; their colour above is a dark orange-red, with two edgings of respectively blue and black; the upper wings have spots of black about their centre, and abbreviated bands of black in their front; and the lower wings have, near the middle of their front margin, a large spot of black. The caterpillar feeds principally on the cherry, the elm, and the willow.—The small tortoise-shell butterfly, *Vanessa urticae*, is one of the most abundant and beautiful of the British species; and abounds also in most parts of continental Europe. It bursts into activity, in our climate, during fine days and streams of sunshine in February and March, and is therefore called by Linnaeus “a deceitful harbinger of spring;” but, in Italy, it continues on the wing during the comparatively fine days of the whole winter. It abounds on the nettle plant; flits agilely and

lightly from flower to flower; and, though considerably smaller than the large tortoise-shell butterfly, closely resembles that species in appearance.—The red admiral, *Vanessa atalanta*, is very common in all parts of Britain, and most other parts of Europe. Its wings have a velvety-black colour, belted with red, and variegated with white and blue. Its caterpillar has a greenish-colour, with a longitudinal line of yellow spots; and it feeds on the nettle.—The peacock's-eye butterfly, *Vanessa io*, is also very common. Its colour is a dark brownish or purplish red; and on the upper surface of each wing, is a dark eye-like spot.—The common copper butterfly, *Lycæna phlæas*, is pretty common throughout Britain and most of continental Europe, and occurs also in Asia and North America. It appears in June, July, and August. Its colour is variable; but, in general, that of the upper wings is richly coppery, spotted and broadly margined with black.—The great fritillary, or silver-washed fritillary, *Argynnis paphia*, occurs in most districts of Britain, and appears about the sides of woods in June. Its wings are of a bright orange-brown colour, and have several black marks near their centre, and three rows of black spots along their border. Its caterpillar has a tawny colour, with hairy spires, and a yellow dorsal line; and feeds on the nettle, the dog violet, and some other plants.—The silver-studded blue butterfly, *Polyommatus argus*, is not uncommon in the southern and midland districts of England, and appears in June, fluttering over clover-fields and broomy pastures. The wings of the male have a deep blue colour, edged with white; and those of the female have a dull brownish-black colour. Its caterpillar feeds on the broom.—The small heath butterfly, *Hipparchia pamphilus*, is common on grassy hills, and upland pastures, and dry moors in every district of Britain. The upper surface of its wings has an ochreous or pale-orange colour, and is fringed with long white hairs; the under-surface of the fore-wings is clouded with ashy colour, and has near the tip an ocellated black spot with a white centre; and the under-surface of the hinder wings is clouded with grey and greenish brown, and has two or three obscure ocellated spots.—The Glanville fritillary, *Melitæa cinxia*, is rare in England, and occurs on the Isle of Wight and the hills of the southern sea-board. Its colour is orange-red, marbled and spotted with black and yellow; but that of its caterpillar is black, dotted with white.—The Duke of Burgundy fritillary, *Nemeobius lucina*, occurs principally in the south-eastern counties of England, and usually appears about the middle of May. Its wings have a dark-brown colour; and the upper pair are marked with three transverse bars of irregular yellowish spots.

Butterflies themselves, or the insects in their imago state, do no harm to vegetation, either using no food whatever, or merely sharing the repast of the bee from the nectaries of flowers; and

hence both farmer and gardener may admire their beauty, and observe their flights, without other care respecting them than to prevent, in all the mischievous species, the depositing of their eggs. The caterpillars of all the kinds noticed in the preceding long paragraph feed on living plants; but, in some instances, the plants which they select are mere weeds, and, in others, they seldom suffer sufficient injury to occasion any considerable or almost perceptible loss to cultivators. Yet the species of the genus *Hipparchia* may probably be regarded by some farmers as an exception, for they feed on the most valuable of our pasture-grasses; and they appear every year in such numbers, and occasionally in such vast swarms, as necessarily to consume a considerable portion of prime and nutritive herbage. The caterpillars of the first six species which we named, however, are so general and mighty foes as to require for their respective butterflies a somewhat extended notice.

The common cabbage butterfly, *Pontia brassica*, is the type, and the largest species, of all the garden white butterflies. The club of its antennæ is abrupt, compressed, and obconic; the terminal joint of its palpi is longer than either of the two preceding joints; the claws of its legs are slightly forked; the upper surface of its wings is white, with a large patch of black; and the wings of each of the sexes have some additional and characteristic markings, chiefly in black. Its eggs have a bright yellow colour, and a somewhat conical shape, with raised, granular, longitudinal ribs, connected by elevated cross lines; and they are deposited by the butterfly, in a thick cluster, on the leaves of the numerous varieties and sub-varieties of *brassica oleracea*, and sometimes, though rarely, on the leaves of the turnip. The caterpillar—one of the most popularly known of all the British larvæ—has a bluish-green colour, with a narrow line of yellow along the back, and another along each side of the belly; and its body is pretty thickly studded with black tubercular points, each with a hair in its centre. So destructive is this caterpillar that the outer leaves of many brassica plants in almost every garden may be seen pierced, and riddled, and eaten away by it; and not only are these rendered useless for the coarse economical purposes to which they might be applied, but the interior or culinary parts of the plants, especially in the case of cauliflower and broccoli, is seriously though indirectly injured. A net spread over the plants would prevent the deposition of the eggs by the butterfly; and hand-picking is the most effectual method of removing the caterpillars. The chrysalis has a pale green colour, spotted with black, and is attached by the tail, and a silken band round the middle. But a hymenopterous parasite, *Microgaster glomeratus*, destroys many of the caterpillars by depositing its eggs in them, and prevents their transformation into chrysalides. The larvæ of this parasite feed

on the internal parts of the caterpillar till they are ready to become pupæ; and they then eat their way through the skin, and become transformed into small oval cocoons, covered with a bright yellow silk, and lying clustered around the remains of the caterpillar. Another small ichneumon, *Pteromalus puparum*, attacks the caterpillar; and, in this case, the chrysalis becomes brown. When caterpillars climb walls, enter outhouses, and effect other and similar retreats, they are on their way to secluded situations for transformation into chrysalides.

The small white garden butterfly, *Pontia rapæ*, closely resembles the common cabbage butterfly in every characteristic, except its being smaller. But its caterpillar has both a decidedly different appearance, and somewhat different habits. Its colour is light green, with a pale line along the back, and a whitish streak, slightly punctured with yellow, on each side of the belly. It feeds on the same plants as the common cabbage caterpillar, but insinuates itself between the folds of their central leaves, and is so difficult to be reached, that it not unfrequently escapes the search of both gardener and cook, and finds its way as part of the brassica dish to the table. The small white garden butterfly, therefore, ought either to be warded off from brassica plants by net-covers, or caught and destroyed by means of net-bags.

The green-veined white butterfly, *Pontia napi*, is the smallest of our white garden butterflies. It has a white colour, inclining to yellow,—the tip of its upper wings dusky,—a round black spot near the middle of the upper wings of the male,—and two such spots in each of the upper wings of the female; but it exhibits considerable variations in the depth of its colours. The caterpillar has a dull green colour, lighter on the sides, with yellow stigmata, and covered with white warts, which are blackish at the tip, and tufted with short hair; and it feeds on many species of cruciferous plants, but gives a preference to those of the brassica genus.—Several other kinds of white garden butterflies have been described; but, though regarded by some entomologists as distinct species, they seem to be mere varieties of the three kinds which we have noticed.

The hawthorn or black-veined white butterfly, *Pieris crataegi*, is readily distinguishable from the garden white butterflies by its conspicuous, black wing-veins. Its antennæ are somewhat slender, and their club the opposite of abrupt; the two lowest joints of its palpi are robust, the radical one twice the length of the second, and the terminal one very slender, and about the same length as the second; and its wings are semi-transparent, and have a very small proportion of the scaly or powdery matter with which the wings of most other butterflies abound. The eggs are elongated, longitudinally ribbed, of a bright yellow colour, and rendered weather proof

by a strong natural coating of varnish. The head and neck of the caterpillar are black; and the body is of a dull yellow colour, with a brown stripe along each side, and is pretty thickly beset with hairs. After its first moulting, two rows of yellow spots down the back, and an intermediate black line, make their appearance; and at the third moulting another change in the distribution of the colours occurs. It feeds on very numerous plants of a dendritic and shrubby character; but shows a marked preference for hawthorns, sloe-bushes, pear-trees, and apple-trees. In some parts of continental Europe, the butterfly occasionally appears in such enormous numbers as to be readily mistaken in the air for a shower of snow, and the caterpillar is often very destructive; but, in England, the latter, though mischievous, does not inflict any extensive damage. It gnaws and mutilates the nascent blossom-buds of fruit-trees, so as to render them abortive; but it has such gregarious habits that it can easily be seen and destroyed, particularly on low-growing trees and on wall-trees; and even the eggs whence it emanates are pretty freely betrayed by their bright yellow colour, and may be rubbed from the leaves and branches, and destroyed. The caterpillar is also kept down by titmice and some other birds, by ichneumon flies, and by field-bugs. The chrysalis is usually formed about the beginning or middle of May; it has a yellowish-white colour, thickly spotted and striped with black; and it is attached by the tail and a silk thread round the middle. The transformation into the imago state usually occurs about three weeks after the formation of the chrysalis. This butterfly, though probably unknown in Scotland, has appeared in vast numbers in the south of England; and it is so exceedingly prolific, that it possibly may become extensively diffused.

The meadow-brown butterfly, *Hipparchia janira*, is exceedingly common in every part of Great Britain. The wings of the female have an expanse of about two inches, but those of the male are smaller. The upper wings of the male are entirely brown, with a small ocellus towards the apex, encircled with reddish-yellow; and the lower wings are usually brown, without any spots. The upper wings of the female have in the middle a large black ocellus with a white pupil,—below the middle, a large transverse patch of ochre-yellow,—and in the space between this patch and the base, an obscure tinging with reddish-yellow. The caterpillar is light-green, with a white line along each side. It feeds on several grasses, but specially on the smooth-stalked meadow-grass, *Poa pratensis*, which forms a large element in the best herbage of pasture-lands, and most nutritious food of cattle. One of the best methods of collecting and destroying this caterpillar and others which feed on grasses, is to use a large triangular net with a horizontal beam in front, pushing it so smartly along the

surface of the field as to displace the caterpillars and make them fall into it.

The large heath butterfly, *Hipparchia tithonus*, is considerably smaller than the meadow-brown butterfly. Its upper wings are reddish-yellow, the base brown, the anterior and outer sides broadly margined with dark brown, and the front angle marked with a rather large black spot; and its lower wings are brown with a large reddish-yellow area in the middle, having on one side of it a minute ocellus. The male is much smaller and more deeply coloured than the female, and has a brown cloud in the middle of the lighter portion of its upper wings. The head of the caterpillar is brown; and its body is greenish, with a reddish line on each side. This caterpillar feeds on the annual meadow-grass, *Poa annua*, which forms a chief part of the herbage of many of our meadows and pasture lands. Some of the insects described by agricultural writers as butterflies which damage crops, really belong to other divisions of entomology, particularly to that of moths. See the articles **MOTHS** and **CATERPILLARS**.—*Westwood's Introduction to Entomology*.—*Koller's Treatise on Insects injurious to Gardeners*.—*Museum of Animated Nature*.—*Cuvier's Animal Kingdom*.—*Papers by Mr. Duncan in Quarterly Journal of Agriculture*.—*Mill's Husbandry*.

BUTTERFLY - PLANT. See **ORCHIS** and **ONCIDIUM**.

BUTTERJAGS. The flowers of the wild trefoil. See **TREFOIL**.

BUTTERMILK. The residuum of churning, or the caseous and serous portions of milk which remain after the butyraceous portions are separated. When the milk delivered into the churn has not had its coagulum or lapper previously broken, and has not passed into any degree of fermentation, the resulting buttermilk has a pleasant, palatable, slightly acidulous taste, perfectly free from acidity and bitterness; and, if not placed in too high a temperature, it will remain for a long time good and agreeable, free from fermentation, and without any separation of its caseous from its serous elements. But whenever the milk, before churning, has had its coagulum broken, and has fermentingly run into curds and whey, the resulting buttermilk will continue to ferment, and will suffer a rapid separation of its caseous from its serous elements, and will very speedily become both unpalatable and unwholesome. Good and well-made buttermilk is better with a mixture of one-fourth or one-fifth of its volume of water, than fermenting and ill-made buttermilk without one drop of water. All buttermilk which is curdly, or which has a sharp or bitterish taste, ought to be rejected as totally unfit for the use of man.

BUTTER-NUT,—botanically *Caryocar*. A genus of large tropical fruit-trees, constituting the natural order Rhizophoræ. The genus was called Rhizopholus by Goertner, and Pekea by Aublet;

and, under the former of these names, it was made the type of its own order. The trees composing it are natives of Guiano and Essequibo. They differ from those of the turpentine-tree tribe, chiefly in the structure of their fruit, and the hypogeneity of their stamina and petals; and from those of the horse-chestnut tribe, principally in having large radicles and small cotyledons. Three species, the smooth, the woolly, and the nutbearing, were, about twenty-five years ago, introduced to the hothouses of Great Britain; and all these are evergreens, and usually grow to the height of about one hundred feet. The nut-bearing species, however—*Caryocar nuciferum* or *Caryocar sonari*, was not introduced in a living state, but exhibited in drawings from the island of St. Vincent. Its flowers are very large, the calyx two inches broad, the stamina upwards of 4,900 in number, and the corolla consisting of five large, elliptical, concave petals, purplish brown outside, and yellow and red inside. Its nut, frequently called the Suwarrow nut, is not uncommon in the London fruit-shops; and its kernel is of a pure ivory-white colour, soft and fleshy, somewhat oily, and of a very agreeable flavour. The total number of species known to botanists is six.

BUTTER-NUT (GREY),—botanically *Juglans cinerea*. A hardy, deciduous tree, of the walnut genus. It was introduced from North America to Great Britain, about the middle of the 17th century; and is sometimes called the Pennsylvanian walnut. Its stem usually attains a height of about thirty feet; its leaves are pinnate, and very long—each comprising about eleven pairs of folioles, and a terminal odd one; its apetalous flowers appear in April and May; and its nuts vary in size upon different varieties of the tree, but, in general, are small, roundish, and hard-shelled. See the article **WALNUT**.

BUTTERWORT,—botanically *Pinguicula*. A genus of aquatic plants, constituting, with the hooded milfoils, the natural order Lentibulariæ. All the plants of this order are aquatics, and either interesting or curious; but most are unsusceptible of cultivation. Two species of butterwort, the common and the Portugal, grow wild in the bogs of Great Britain; one, the large-flowered, grows wild in the bogs of Ireland; two, the yellow and the toothless, have been introduced from North America; and nine or ten others have been scientifically described. The common species, *Pinguicula vulgaris*, has a height of about six inches, produces violet-coloured flowers in May, and is employed for several economical and medicinal purposes. Its leaves are thick and glutinous, and have an oleaginous or greasy character; and this feature is referred to in both the popular and the botanical names of the genus,—the latter being derived from a word which signifies 'fat.' The viscid exudation of the leaves is regarded as a remedy for soreness in the teats of cows; a syrup made from it is used by some

country people as an aperient; an ointment made from it is used for healing the bite of adders and excoriations of the hands; and the plant itself is sometimes boiled up with garden vegetables as a remedy for colds.—The large-flowered species, *Pinguicula grandiflora*, is a very beautiful plant, of three or four inches in height, and producing blue flowers in April and May.—The two species which have been introduced from America also possess much beauty, but are somewhat tender.

BUTTON-FLOWER,—botanically *Gomphia*. A genus of evergreen, ornamental, tropical shrubs, of the ochna tribe. Five species have been introduced to Great Britain from the West Indies, and one from Ceylon; and about twenty other species are known to botanists. Their leaves are lucid, their flowers yellow, and their germens club-shaped; and the last of these characteristics is alluded to in the name *Gomphia*, which signifies "a club." The bark of *Gomphia hexasperma* is used in Brazil for healing sores in cattle, inflicted by the stings of insects.

BUTTON-TREE,—botanically *Conocarpus*. A small genus of evergreen hothouse shrubs, of the combretum tribe. The upright species, *Conocarpus erectus*, was introduced to Great Britain from Jamaica, about the middle of last century. It grows plentifully in sandy bays in all parts of the West Indies. Its stem is upright, ramified, and from ten to sixteen feet high; its leaves are spear-shaped and alternate, and stand on broad short footstalks; its flowers grow on ligneous footstalks from the wings of the leaves, are produced in six or eight conical heads at the end of each branch, and present a considerable resemblance to the flowers of acacia; and its fruit is a cone of scales, enclosing single seeds, and giving rise to the botanical name *conocarpus*, which signifies "a conical fruit." The wood of this species is used as timber.—The procumbent or maritime trailing species, *Conocarpus procumbens*, has short crooked branches, which divide and spread out on all sides athwart the ground; and it was introduced from Cuba in the former half of last century. Two species, with white flowers, and about twelve feet high, were recently introduced from South America.

BUTTON-WEED,—botanically *Spermacoce*. A genus of herbaceous plants, of the madder family. Upwards of twenty species have been introduced to Great Britain,—principally from the West Indies; and upwards of forty other species are known to botanists. The smooth, the slender, and the lanceolate species are hardy ornamental annuals; the Roxburgh species is an ornamental hothouse biennial; and all the other introduced species are destitute of interest,—most of them tender annuals. Miller thus describes one of the earliest-known ornamental sorts: "It grows to the height of 2½ feet; the stalks are stiff, a little angular, and covered with a brown bark; the branches come out by pairs. There are two leaves at each joint placed opposite, which are

two inches long, and almost a quarter of an inch broad; and between these come out three or four smaller, which stand in whorls round the stalks; they are smooth, and have one strong vein or midrib in the middle. The flowers grow in slender whorls toward the top of the stalks; they are small, white, and sit close to the stalks, having a whorl of small leaves close under them; these are succeeded by two oblong seeds, having small horns which ripen in the empalement."

BUTTON-WOOD,—botanically *Cephalanthus*. A small genus of plants of the madder family. The western species, *Cephalanthus occidentalis*, is a hardy, deciduous, ornamental shrub; and was introduced to Great Britain from North America in 1735. It usually grows in this country to the height of about six or seven feet; its branches are few and open proportionally to the foliage, and do not render it a very bushy plant; its leaves are three inches long and one and a half broad,—they stand opposite by pairs, and sometimes by threes, and are of a light green colour,—they are smooth in their upper surface,—they have several strong nerves, one from base to point, and the others from this to the borders,—and these nerves, as well as the footstalks, become reddish in autumn; its flowers are produced in globular heads or aggregates, at the ends of the branches, in July or August; and the florets which compose the flowers are whitish-yellow, funnel-shaped, and fastened to a central axis. The botanical name *cephalanthus* is compounded of two words which signify "a head" and "a flower;" and alludes to the globular aggregation of the floral growth. The elder Michaux found in the island of Ohio a button-wood plant which, at five feet from the ground, measured 40 feet 4 inches in girth; and the younger Michaux saw, on the right bank of the Ohio river, 36 miles from Marcetta, one which, at four feet from the surface, measured 47 feet in circumference, which appeared to preserve the same dimensions to the height of 15 or 20 feet, and which then divided into many limbs of proportional size. The western button-wood can be propagated in Britain from layers and cuttings,—but not without considerable care; and is better and more commonly propagated from seeds. Two other species are known to botanists, but have not been introduced to Britain.

BUTYR OF ANTIMONY. See **ANTIMONY**.

BUTYRINE. The fatty principle which constitutes butter. Like other animal fats and oils, it consists of the simple elements of carbon, oxygen, and hydrogen; and, like the latter, it comprises the proximate elements of stearine and elaine. But, unlike the common animal fats, it becomes quite fluid at 70° of Fahrenheit; and when converted into soap, it yields, in addition to the usual products, three volatile odoriferous compounds, called the butyric, the caproic, and the capric acids.

BUXUS. See **Box-TREE**.

BY-LAW. A particular law made by a corporation, or by any other distinct portion of the community, for the regulation of the affairs of its members in such of their relations as are not reached by the general law of the land. Such private laws may legally be made by all incorporated bodies, as civic corporations, trading companies, &c., and even by the body of the inhabitants of a town or parish, provided they involve the infraction of no public laws, but are merely calculated to supply their want of application in the particular instance. These private laws are binding only on the members of the body for which they are framed, and will not be recognised as valid unless they appear to be intended for the general good of that body, and not for the mere furtherance of private or personal interests.

BYRSONIMA. A genus of ornamental, evergreen, ligneous, tropical plants, of the Barbadoes-cherry tribe. The name Byrsonima is formed from a word which signifies "a hide;" and it alludes to the richness of the bark of the plants in tannin. Upwards of thirty species have been described by botanists; and thirteen of these have been introduced to the hothouses of Britain. Nine of the introduced species were formerly classed with the malpighias; and both they and all the other species have a very close relationship to that genus. The loftiest species, *Byrsonima altissima*, usually attains a height of about 60 feet; and both this species and some others are of use in warm countries for their timber. Most of the introduced species are merely tall shrubs; one, *Byrsonima volubilis*, is a twiner; all are handsome; and most are natives of the northern part of South America, and the adjacent islands of the West Indies.

BYTTNERIA. A genus of plants, partly shrubby and partly herbaceous, forming the type of the natural order Byttneriaceæ. This order comprises twenty-eight genera; and has, within the gardens of Great Britain, upwards of 150 species. One section or tribe of the order con-

sists of the single genus *eriolæna*, and five other sections, into which it is divided, are severally represented by the genera *byttneria*, *sterculia*, *lasiopetalum*, *dombeya* and *hermannia*. The six tribes are distinguishable from one another only by very minute botanical characteristics; and even the whole order is distinguishable from the mallow and the silk-cotton-tree orders, chiefly by the mere bilocular character of its anthers. Some of the species are superlatively beautiful; and not a few are, in various respects, economically valuable. Many of the *sterculias* are fine umbrageous trees; several species produce seeds which are much esteemed for the dessert; the *theobroma* genus yields the well known chocolate and cocoa of the tea-shops; a species of *pentapetes* yields a cooling mucilaginous juice which is medicinally employed in gonorrhœa; and a species of *guazama* yields productions which are severally used for the dessert, for promoting perspiration, and for clarifying sugar.—About twenty species of the genus *byttneria* have been described by botanists; and eight of these have been introduced to the gardens of Britain. Two of the introduced species, the thick-leaved and the *hermannia*-leaved, are greenhouse, ornamental, evergreen shrubs, of three or four feet in height; and the others are hothouse plants of little interest.

BYZANTINE NUT,—botanically *Corylus Colurna*. A species of hazel. It is a small, hardy, deciduous, nut-bearing tree; and was introduced to Great Britain from Constantinople in 1665. It usually attains a height of about ten feet; its stipules, instead of being oval and obtuse like those of the filbert, are narrow and acute; its nuts are roundish, and twice the size of those of the common hazel; and its calyx is very large, so as almost to cover the nut, and is deeply cut at the brim. Its other characteristics, and its mode of propagation, are the same as those of the common hazel. A hybrid between it and the filbert, called *Corylus colurna intermedia*, has recently become known in the nurseries.

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CAAPEBA,—botanically *Cissampelos Caapeba*. A tender, evergreen, ornamental, twining, dioecious plant, of the moonseed tribe. It grows wild in the tropical parts of South America, and was introduced thence to British hothouses during the former half of last century. It naturally twists about every shrub in its vicinity, and attains a height of five or six

feet. Its leaves are round heart-shaped, hairy on their under surface, and standing on pretty long slender footstalks, which are set within the leaves' base; and its flowers are greenish, and come out from the wings of the leaves, toward the upper part of the stems,—those of the male plants growing in short spikes or clusters,—and those of the female plants produced in long loose racemes, and

succeeded each by a single pulpy berry, enclosing a single seed. Its root possesses diuretic properties.

CABBAGE,—botanically *Brassica*. A group of hardy herbaceous plants, of the cruciferous tribe. The cabbage, as understood in a loose sense, and with considerable variations of meaning, has very long made a conspicuous figure in the history of vegetable cultivation. It appears to have been generally and very early cultivated by the ancient Greeks and Romans. It was called by some of the earlier classical writers, *Raphanus*, from the resemblance of its seed to that of the radish; and by some less ancient writers, *Corambe*, from a supposed tendency in it to injure the eyesight. The botanical name *Brassica*, is simply a modification of *Bresic*, the Celtic name of the plant; the popular name cole or colewort, is supposed to be derived from the Latin word *Caulis*, and to allude to the excellence of the stems; and the popular name cabbage is remotely from the Latin word *Caput* or the old French word *Cab*, both signifying a head, and proximately from the Italian *cabuccio* or the Dutch *kabuya*, and alludes to the firm head or ball which is formed upon the most conspicuous varieties of the plant by the natural convolution of the leaves, technically designated cabbaging or bolting.

The Greeks held the cabbage in high esteem; and the ancient Romans—in one of those fabulous flourishes which pass by courtesy for classic history—are said to have expatriated their physicians, and, simply by the use of cabbage, to have preserved their health during six hundred years. Both the Greeks and the Romans eat the raw leaves of cabbage, as a preventive and an alleviation of the effects of intoxication. Pliny praises the spring shoots of cole or cabbage, and says, "I dwell long on this vegetable, because it is in so great request in the kitchen, and among our riotous gluttons." Several ancient writers ascribe to the cabbage various medicinal properties, and assert, in particular, that its juice or its seed, taken in drink, is a good antidote against the effects of the poisonous species of mushrooms. Several kinds of coles were in favour among the Romans: those of Calabria were the most hardy; the Sabellian were the sweetest and best flavoured; those of Cumæ bore leaves which spread flat along the ground; and those of Aricia were tall, and produced numerous buds.

Some variety of cabbage, though we know not which, was probably introduced to Britain by the Romans. The Saxons use the word "kale" in their oldest extant records; and gave the name "sprout-kale" to the month of February, on account of the young leaf-buds then beginning to be fit for use. Gerard is the oldest English author who has written fully on the cabbage; and he mentions several kinds, whose seeds were brought from the Continent, and recommends that they be carefully "set and sown in the same manner as musks, melons, and cucumbers." The bolled

or firm-hearted variety, which is emphatically designated cabbage, was, for a long time, imported, in a market-state, into England from Holland. It was first introduced to English cultivation by Sir Anthony Ashley in Dorsetshire; yet it very slowly passed into favour with cultivators; and, half a century afterwards, when Ben Jonson wrote, it was still imported to our markets from Holland. "It seems," says a writer in the Magazine of Domestic Economy, "that Scotland was still more tardy in receiving the gift which now forms a great article of subsistence among her labouring population, it being said that the soldiers of Cromwell first carried the cabbage into the Highlands. But although we acknowledge that there is proof of Cromwell's attention to the physical wants of those whom he so vigorously governed, yet in this case, perhaps, we should rather refer the introduction of cabbages into Scotland to the colonies of German fishermen who settled upon the eastern coast of that country at a period much earlier than the Commonwealth. The cabbage and open colewort now form the principal ingredients of a kind of soup to which we find continual allusions in the songs of Burns."

Cabbage, in the loose and improper sense of the whole brassica genus, has already been disposed of in the article BRASSICA. In its botanically proper sense, it comprises all the varieties and subvarieties of the species *Brassica oleracea*; and, in its more stringent or distinctive popular sense, it includes only such subvarieties of this species as have smooth bolled heads. One group of the subvarieties of *Brassica oleracea* has been called *B. o. acephala*, and includes the borecoles, the cavalier cabbage, the thousand-headed cabbage, and some others; a second has been called *B. o. costata*, and includes principally the cove tronchuda and the chou a cotes; a third has been called *B. o. bullata*, and includes the savoy cabbage and the Brussels sprouts; a fourth has been called *B. o. botrytis*, and includes cauliflower and broccoli; a fifth has been called *B. o. caulorapa*, and includes the Kohl-rabi and the chou-rave crepue; and a sixth has been called *B. o. capitata*, and includes the kinds which are most strictly designated cabbages. If the first and the second of these be conjoined, and also the third and the last, four groups will be formed with very conspicuous and easily recognisable popular characters,—the first loose-headed, the second bolled-headed, the third corymbose-flower-budded, and the fourth turnip-rooted. In our subsequent remarks, we shall include under the notion of cabbage, the wild normal plant of *Brassica oleracea*, all the subvarieties of *B. o. capitata*, and such of the subvarieties of *B. o. acephala* as are cultivated in the fields and not popularly classed with the borecoles; and we refer, for notices of the other subvarieties of *Brassica oleracea*, to the articles BORECOLE, BRUSSELS SPROUTS, SAVOY, KOHL-RABI, BROCCOLI, and CAULIFLOWER.

The wild cabbage grows wild on the rocky shores of Great Britain, and particularly on the sea-cliffs of some parts of England. Its root is fusiform, and somewhat hard; its leaves are smooth, glaucous, waved, irregularly lobed, somewhat thick or fleshy, and generally rather lyrate-shaped; its flowers are yellow, and appear from April till June; and its pods are not beaked. Except for the colour and smoothness of its leaves, it presents, when in flower, a considerable resemblance to charlock, *Sinapis arvensis*; and though the parent of numerous, prominent, and valuable kinds of both field and garden esculents, it is itself utterly undeserving of cultivation, and takes rank with some of the most worthless sorts of bulky weeds. "The brassica oleracea," remarks Dr. Neill, "is a plant indigenous to our rocky shores; but no one, seeing it waving its foliage in its native habitat, could possibly anticipate that it would ever appear in our gardens, disguised as the ponderous drum-head or sugar-loaf cabbage, or on our tables as the delicate cauliflower or broccoli.

The cow cabbage, *B. o. acephala arborescens*, is one of the most remarkable of the field subvarieties; and has frequently been the subject of exaggerated recommendation and wildly impassioned eulogy. It also bears the names of Anjou cabbage, Jersey kale, branching cabbage, Cæsarian cole, chou chevalier, chou a vaches, and several other designations. Its root is large and spreading; its stem is upright, strong, and usually from five to ten feet high; its branches are numerous, and form a head upon the stem somewhat similar to that of a palm; both its stem and its branches are very hard and almost ligneous; and its leaves are small, thin, smooth, and vivid green. It is extensively cultivated in Jersey and in some of the north-western parts of France; and is there used, not only for the forage of its leaves, but for the ligneous value of its stems. It seems, like almost every other subvariety of *Brassica oleracea*, to have undergone modifications from natural hybridizing; and, in consequence, it has, under new names and with slight changes of appearance, been again and again introduced to the attention of British farmers, and as frequently dismissed. The Anjou cabbage form of it had great though brief popularity about the middle of last century, and was introduced to England from the French estates of the Marquis of Turbilly. "This kind of cabbage," said the Marquis, "is one of the most useful leguminous plants for country people. It is greatly esteemed in Anjou, Poitou, Brittany, Le Maine, and some other neighbouring provinces. In Anjou, farmers are bound by their leases to plant yearly a certain number of these cabbages, and to leave a certain number of them standing when they quit their farms. This cabbage forms a kind of shrub, the great utility of which may be gathered from this, that its leaves afford nourishment to men and cattle, and its stalk, which is

about the thickness of one's wrist, is used, when dry, for fuel." A kind of cow cabbage cultivated in La Vendee, and strongly recommended about eighteen years ago to the notice of British farmers, is said to attain, in its native district, a height of from 12 to 18 feet. "Sixty plants of it," reported Mr. Hamilton of Plymouth, "are said to afford sufficient provender for one cow for a year; and as the side shoots only are to be used, it lasts four years without fresh planting. A square of sixty feet will contain 256 plants, four feet apart, or sixteen more than four cows require for a year's provender, without the aid of other food." The kind of cow cabbage called the Cæsarian cole was introduced to England by Mr. Fullard, and was asserted by that gentleman's cowherd to be so superlatively prolific, that five plants of it per day are, with proper management, sufficient for ten oxen or for one hundred sheep. In 1836, living plants of it six feet high, and raised from seed which had been purchased at a shilling a-grain, were exhibited at the Bedford conservatory in Covent Garden; and some plants of it in the ordinary course of culture are said to attain a height of twelve feet, and a circumference of from fifteen to twenty feet, and to possess stems of sufficient strength to be used as rafters for the thatched-roofs of farm-buildings. Another kind of cow cabbage recently introduced from France is called Chou Laponic or Lapland cabbage, and differs very slightly from the other kinds, yet may be considered as slightly improved.

The Jersey kale, though usually regarded as a cow cabbage, seems to possess an intermediate character between that subvariety and the thousand-headed cabbage. An account of it which appeared about fifteen years ago, and drew considerable attention, says, "It is much cultivated in Jersey, and attains the height of from four to ten or twelve feet. The little farmers feed their cows with the leaves, plucking them from the stem as they grow, and leaving a bunch or head at the top. The stems are very strong, and used for roofing small out-buildings; and after this purpose is answered, and they are become dry, they are used for fuel. When the gathering of the leaves is finished at the end of the year, the terminating bud or head is boiled, and said to be particularly sweet." But all the eulogistic accounts of the Jersey kale and of the several kinds of true cow cabbage have been found by experiment to be essentially fallacious and mightily deceptive. An acre of common red clover, under any ordinary circumstances, probably yields as large an amount of nutritive matter, and quite as profitable an aggregate return, as an acre of any average sort of cow cabbage.

The thousand-headed cabbage, *B. o. acephala vulgaris*, presents a considerable resemblance to the cow-cabbage, but is more compact in its head, and both rougher and darker-coloured in its leaves. About 40 years ago, Mons. Lecochere cultivated it to a considerable extent in the

vicinity of Guildford, published a small tract on its merits, and made strenuous efforts for its diffusion; and, within the last fifteen years, many of the principal seedsmen of Britain have grown the seed of it for sale; yet it has obtained comparatively little favour, and is found to be less valuable than the drumhead and the Scotch cabbages.—The branchy or Cavalier cabbage, *B. o. ramoza*, is merely one of the sorts or forms of the common cabbage.—All the subvarieties and kinds now enumerated belong to the open-headed or borecole group, and are cultivated solely for the use of cattle. Some of the true borecoles, also—particularly Scotch kale and German greens—are occasionally grown in the fields as forage crops.

The Cove tronchuda or Portugal borecole, *B. o. costata oblonga*, has an intermediate character between the borecole group and the bolled or true cabbages. It is likewise called the oblong cabbage, the large-ribbed borecole, and Chou vert à larges côtes. It was extensively introduced about twenty years ago from Portugal; and is cultivated principally in the neighbourhood of Braganza. Its usual height is nearly two feet; its head is loose and open; its leaves are large and rugose, and its costæ, côtes, or midribs, are large, thick, and almost white, and branch into whitish veins. Its heart or central part is tender, very delicate, agreeably flavoured, and free from the coarseness which often belongs to the common cabbage; and the ribs of its exterior and larger leaves, when divested of the thin green parts, and well boiled, make a good dish, somewhat resembling sea-kale. This plant, however, is too delicate to be cultivated in the fields, and even too tender to be cultivated as winter-greens in the garden; and, as to at once its habits, its culture, its uses, and its economical value, it has a far closer relation to cauliflower and sea-kale than to borecoles and true cabbages.—The common large-ribbed borecole, or Chou à grosses côtes, *B. o. costata vulgaris*, holds the same intermediate place between the true borecoles and the true cabbages as the preceding.—The dwarf cove tronchuda is simply a modified form of the Portugal borecole, growing to the height of eighteen inches, and producing sprouts.

All the bolled or true cabbages are distinguished by the plainness and smoothness of their leaves, and by their habit of so bundling together all their leaves except the outer ones as to form a compact, hard, blanched, globular or roundly-conical head. The drumhead or depressed subvariety, *B. o. capitata depressa*, and the great round Scotch subvariety, *B. o. capitata sphaerica*, are generally esteemed the most suitable for extensive field cultivation. The York subvariety, *B. o. capitata elliptica*, and the conical or sugarloaf subvariety, *B. o. capitata conica*, are suitable for both the field and the kitchen-garden. The York, in particular, has a very wide range of adaptation, exists in a considerable number of forms

or sub-subvarieties, and possesses an eminent degree of aggregate excellence. The best early York combines all the best qualities of the cabbage,—firmness of bolting, compactness of heart, sweetness of flavour, convenience of size, hardiness of habit, and facility of culture.—The red subvariety, *B. o. capitata rubra*, is strongly characterized by the deep purple colour of its leaves; and, for the most part, is cultivated only in small quantities in the kitchen garden, to be prepared and used as a pickle. The Vanack cabbage is an old kind, which fell into almost total neglect, and has recently been re-introduced to notice. It may, by means of timely sowings, be always in season; and it makes excellent spring coleworts, becomes very early a white-hearted cabbage, pushes fine sprouts from the stump after the heads are cut away, and is inferior in quality to few of the best cabbages. Other generally known kinds, and even distinct subvarieties of cabbage, are somewhat numerous; and kinds slightly marked, obscurely known, evanescent in character, or merely local in cultivation, must, from the powerfully hybridizing tendency of the genus, be absolutely multitudinous. A good selection is the following;—for field or cattle crops, the drumhead, the great round Scotch, the great American, and the large round winter; for pickling, the red Dutch, and the great drumhead; for early spring garden crops, from April till June, the small early dwarf, the early dwarf York, the Eastham, and the dwarf sugarloaf; for general summer garden crops, the large early York, the large sugarloaf, the Battersea, the Penton, the Antwerp, the Russian, and the imperial; and for general autumn garden crops, the oblong hollow, the long-sided hollow, and the large hollow sugarloaf.

Almost any soil, provided it be exposed to the full influence of light and air, and be not shaded or stifled by shrubs, trees, or buildings, is suitable for the growth of cabbages; and many a soil which is too stiff for the profitable cultivation of turnips is eminently adapted to a rotation comprising cabbages, beans, and wheat. But the most suitable soil for cabbages is a sound, mellow loam, of the peculiar quality and texture usually designated fat or unctuous, having silex in very large proportion, in extremely minute division, and combined with a greater degree of aluminous earth than in most common, gritty soils. Yet the unctuousness of fat loam is occasioned more by the comminuted state of its silex, than by any considerable intermixture of alumina or calcium; for some unctuous loams, possessing thorough adaptation to the growth of cabbages, have been found, on analysis, to contain not more than five or six per cent. of clayey matter, and scarcely one grain of chalk. Excellent land for the field cultivation of cabbages is either wet sandy loam, or a deep clay in a moist and almost marshy situation; but either of these—or indeed any description of land for cabbages—requires to

be profusely enriched and thoroughly incorporated with spit dung or with some of the best kinds of composts, and will also yield a fair return for a subsequent dressing with the drainings of the stable or with other liquid manure.

All the kinds of cabbage are sown in spring to boll and be used in the autumn and winter of the same year; and again in the end of summer or beginning of autumn, to boll and be used in the spring and early summer of next year. Most cabbage-growing farmers in the south and centre of England, plant a succession in April and May, and even till the end of June, so as to have a constant supply of fresh plants up to the time of their beginning to run to seed. The best time for sowing with a view to afford supplies in spring is from the 6th till the 12th of August in the southern and central counties of England, and from the 15th till the 30th of July in the north of England and south of Scotland; and the best time for sowing with a view to afford supplies in autumn is toward the close of March, or in the early part of April. Plants from a sowing early in July are liable to run to seed in the spring; and plants from a sowing in the latter part or even middle of August seldom acquire sufficient strength to resist the rigours of winter.

Cabbages, for growth in the garden, and even for growth in the field, are usually raised in seed-beds, and afterwards transplanted. The soil for a seed-bed ought to be moved to the depth of a few inches, and made very fine. The line for indicating the drill is strained tight; the drill is cut by drawing the angle of a hoe in the direction of the line, with its edge resting against it; the depth of the drill is an inch or even less; the bottom of the drill is gently compressed into a smooth grooved surface, by means of the cylindrical back of a wooden rake, or of a long, smooth, slender pole such as the handle of a rake; the seeds are scattered, as regularly as possible, along the bottom; a mixture of two pounds of powdered quicklime, one pound of coal-soot, and one ounce of flowers of sulphur is dusted over the seeds, as a protection from the attacks of insects; and the drill is filled up with fine soil, and made firm and even by pressure with the flat of the spade. If the ground be in a somewhat moist condition, and the weather be somewhat showery, nothing more needs to be done; but when the soil, at the proper time for sowing, happens to be dusty or very dry, some artificial aids to germination must be brought into requisition both before and after the sowing. The intended seed-bed, in this latter case, should be copiously watered on each of the three nights preceding the sowing; mats should be thrown over it during the intervening days: and, if sunshine be clear and hot, the mats should be used till the seeds vegetate. The ordinary sprinklings which are usually termed waterings will be of little or no use to sowings in arid soil; and the method of previous drenchings, and of

covering with mats, besides being quite effective, has the advantage of inducing very rapid germination. The sowing ought to be thick, for the several purposes of a precaution against the inertness of a portion of the seeds, a provision against the accidents to which the young plants are liable, and a means of defeating slugs and other tiny foes by gorging them with food. Yet for the last of these purposes, the additional means may be used of sprinkling the young plants with the mixture recommended for dusting the seeds, or of covering the spaces of soil between the drills with dry saw-dust or chaff. When the first true leaves appear, and acquire a little strength, most of the danger from accidents and animal attacks is over, and the young plants ought to be so thinned out as to stand at distances of an inch asunder; and as they advance in growth, they ought to be further thinned to distances of two inches asunder, and the spaces between the rows ought to be slightly hoed, in order to keep the whole bed free from weeds.

The planting or transplanting of cabbage is an operation of prime importance to the culture, whether in the garden or in the field, and requires a little nicety in the performance. Cabbage-plants grown to maturity on the ground on which they are sown, even in spite of the most careful culture, have long unbranching roots, and tall, naked, shanky stems; and they necessarily occasion the preparations and processes of sowing and thinning to be dispersed over a comparatively vast breadth of surface. Transplanting occasions the roots to be "stocky," or to abound in short, bibulous, nutrient fibres; it dwarfs the plants, and both secures them to the soil, and renders them strong and compact; and it enables the cultivator to keep a reserve of seedlings in the seed-bed, and, in the event of very severe weather, to protect them by coverings of mats thrown over arches, formed of hoops or pliable rods. The transplanting ought to be practised as soon as the young plants are about three or four inches high, or begin to be crowded. The bed or plot for it in the garden ought to be in a free open situation, and thoroughly digged, well pulverized, and richly manured. Strong plants, as nearly as possible of uniform height and character, ought to be selected. Plants of any free-growing or large variety ought to be planted 18 inches asunder from one another, in rows 18, 21, or 24 inches asunder; but the small Yorks will do very well at distances of 12 inches from one another, in rows 16 or 18 inches asunder. The soil must be brought closely into contact with the whole of the roots, and made to take distinct hold of every part of each radical fibre. One method is to form a perpendicular drill breastwork, as in transplanting seedling trees, to place the young plants against the breastwork, with their lowest fibres spread upon the bottom, and to render them firm and complete the drill by shovelling up the soil to a level with the sur-

face. Another and more common method is to form dibble-holes of sufficient depth to let the whole root find place without being doubled up, and to make deep lateral pressures with the inserted dibble at the depositing of each plant; or—when the weather is dry—to fill every dibble-hole to the brim with soft water, and so to press the soil at the depositing of the plant as to puddle in and completely secure all the roots. In all instances in which the making of dibble-holes and the filling of them with water is not practised, much good is done by plunging the roots of each plant, immediately before depositing it in the soil, in a thin paste of rich mould and ditch water or the drainings of the dung-hill. If the season of transplanting be early, and the weather be warm and showery, the transplanted cabbages may, in most parts of the south and centre of England, grow so rapidly as to require the check of a second removal, or of being raised up and reset; but almost always in the north, and under all ordinary circumstances in the south, they may be left undisturbed, and will be all the readier for culture at an early period in spring.

Two autumnal hoeings and a moderate earthing up must be given during the progress of the cabbages' growth. If the winter prove mild, they will continue, though very slowly, to grow; and if the winter prove severe, they will be torpid during the prevalence of frost, and will start into somewhat sudden and rapid renewal of growth at the commencement of the genial influences of spring. At the close of winter, the spaces between the drills ought to be cleared from fallen and inert leaves, and once or twice digged or forked; and when the plants indicate their tendency to bolting, the spaces ought to be again well stirred. A few of the plants may run up to seed; but the great majority, if the rules of proper culture have been observed, will form regular heads, and afford a considerable successional supply. The yellow and inert leaves will spontaneously fall, or will yield to the slightest jerk, and ought to be removed; but the firm, green, exterior leaves, which affect an open growth, or refuse to fold over the bolting, ought not, by any means, to be disturbed when the head is cut out, but should be left to perfect the axillary buds which produce young sprouts; and these sprouts or secondary cabbages may be used either as a delicious esculent of somewhat different quality from the original cabbage-heads, or as cuttings for producing a supply of excellent cabbages, true to the original varieties, or undeteriorated by the very common process of natural hybridizing. When the sprouts are designed to become esculent, one or at most two of the best must be selected, and all the rest be rubbed off; for if a considerable number are allowed to grow, all will be small and comparatively worthless; while if only one be allowed to grow, it will rush rapidly to maturity, and

will certainly equal, and not improbably excel, the original head in both appearance and flavour. When the sprouts are employed as cuttings, shoots of about five or six inches in length, are gently twisted from the stem; the lacerated heel of each is trimmed perfectly smooth and even with a very-sharp knife, but not shortened; the cutting, thus prepared, is very carefully deposited in lightish, sandy fresh-moved loam, at such a depth as to insume the greater part of its stem; the dibble or setting-stick is, in three or four places, thrust diagonally into the ground in the direction of the heel, so as to fix it firmly in the soil; and a little water is then given to each plant, to settle the soil closely about its stem.

The seed-bed of the August or July sowing, besides furnishing the seedlings for the crop which is transplanted in the latter part of autumn and used in spring and early summer, is itself an object of considerable care and value. In severe winters, sometimes a considerable part, and occasionally almost the whole of the transplanted crop is destroyed by frost; and, in order to provide against this serious exigency, a proportion of the seedlings ought to be left in the seed-bed. These, however, should be raised up, their longest roots cut back nearly one-third, and the plants reset in regular order and at proper distances. If two hundred seedlings remain, and be made to stand four inches apart in rows which are six inches asunder, a bed of little more than twelve feet in length and about three feet in width will contain the whole; and, in severe weather, this can be kept covered with three or four garden mats, so that it will suffer no injury while the transplanted crop is failing, and will afford a pretty ample supply of plants for spring. —One mode of protecting the transplanted crop is to form deep drills or grooves with the hoe or the spade, and to deposit the plants in these at such a depth that the lowest leaves may stand just above the soil; and another method is to set up the plots in ridges of nine inches in height, and to plant the seedlings in the bottom of the trenches between the ridges. But both methods retard the growth of the cabbages in spring; and the latter has the additional disadvantage of preventing the free and necessary application of the hoe.

The spring sowing, as already stated, ought to be made toward the close of March or in the early part of April. The seed-bed for it should be prepared and cultivated in the same manner as that for the sowing of July or August; and if these two seed-beds be of due extent, and properly managed, they will yield seedlings and shoots for a succession of matured plants during nearly the whole of the year. About the first of June, most of the cabbages from the July or August sowing may be supposed to have yielded their heads for use, and to have been left to produce sprouts from their stems; and at this time, such of the seedlings of the March or April bed as are in a

proper condition to be transplanted, should be carefully selected, and set in a bed of rich soil, watered, and managed in exactly the same manner as those of the July or August sowing. The seedlings which remain in the seed-bed should be gently lifted, the ground stirred, cleaned, and watered, and the plants reset at regular distances of three or four inches asunder. If the plants be multitudinous, a number of the best may, with great advantage, be placed in a succession bed in rows and at distances of six inches asunder; and these, not only will suffer an useful check to their growth, but will acquire ramose and stocky roots. "If," says Mr. Towers, "a bed be formed and planted for cabbaging in June, and thence every two months, and especially if—as I must presume—a previous transplantation had already been made during May, it is obvious that a succession of crops will be secured during every favourable season till the end of October; and I may add, from positive experience, that if the weather be then fine, and the succeeding winter prove open and mild, any remaining stock in the seed-bed, however long-shanked and ungainly they may be, if set deep in the soil of a well-prepared bed, may make good progress till the end of November, survive the winter, and produce excellently-hearted and sweet-tasted cabbages in April. Small they will be, and some perhaps will fly to seed; but those which do succeed will amply reward the attentive care of the grower. My experience applies to the latitude of London, though in a country far westward, and much later in its productions; but I presume that in the north also, these hints may be rendered to a certain extent available."

The field cultivation of cabbages is, as to principle, seasons, and general rules of practice, exactly the same as the garden cultivation; and it differs principally in less attention being given to each individual plant, in the plough and the horse-hoe being substituted for mere hand implements, and in little or no care being used to obtain a succession of supplies by means of nicety in management. The preparatory tillage is nearly the same as that for turnips, but always requires deeper ploughings, and is often effected by one plough following another in the furrow; and land which is clayey and wet, is very generally laid in ridges of, in most instances, four furrows each. When the land is so light and dry as to be advantageously laid flat, the manure is usually incorporated with it previous to the last ploughing; but when it is so adhesive and moist as to require to be laid in ridges, the manure, immediately before planting, is spread in the furrows between the bouts, and the ridges are turned over upon it by being split asunder with the plough. The proper distance between the drills, is $2\frac{1}{2}$ feet for the smaller kinds of field cabbage, and 3 or $3\frac{1}{2}$ feet for the larger kinds; and the proper distance in the row between plant and plant, is the same as the distance between the

drills; but, in order to allow for failures and obtain a full crop, the distance in the row at planting ought to be only one-half of the intended final distance,—leaving the supernumerary plants to be torn up when the desired number are fairly rooted. A frequent method of planting is to lay the land in raised drills, and to deposit the plants by dibbling; but this method permits careless or bungling workmen to set many of the plants with upturned radical stem or without proper pressure of the soil around the radical fibres; and it, in consequence, is very generally followed by the failure of a large proportion of the crop. A much better method is to imitate the usual principle of transplanting large quantities of seedling-trees. The plough opens, in the well-tilled land, a deep and narrow furrow; a woman or a child passes along with a basketful of seedlings, places them at the proper distances against the abrupt side of the furrow, and gives to each a gentle pressure to make it retain its proper position; the plough covers all the roots with the soil turned over on its return; a man passes along, and obliquely presses his foot against the furrow slice at the place of each plant; and the plough either omits the requisite intervening space, or disposes it in shallower and broader furrows, and then cuts the deep and narrow furrow for the next row of plants.

The after-culture consists in horse-hoeing, hand-hoeing, and weeding, and is essentially the same in principle, appliances, and design, as that of other drilled green crops. A frequent method of gathering the crop of the bolting field kinds, is to chop off their heads with a spade, leaving to each an inch or two inches of its stem; but this requires to be modified with some kinds, and cautiously conducted with all. The coleworts, cow-cabbages, and other open-headed kinds, may be gathered by stripping off tier after tier of leaves from the time of the plants being 12 or 20 inches high, till the time of their beginning to run up to seed, and may be allowed to remain on the ground throughout the winter; but the bolting-headed or true cabbage kinds must be very charily bereft of any leaves till the whole are cut away in one head, and ought to be entirely removed from the ground before the commencement of winter; for if single leaves are stripped off, the process of bolting may be enfeebled or prevented,—and if any portion of the crop remain on the ground during winter, its outer leaves are liable to become so much injured as to impart a disagreeable flavour to dairy produce.

The field cultivation of cabbages has often been lauded as at once one of the most eligible, one of the most remunerating, and one of the most shamefully neglected departments of husbandry; and yet it has probably been quite as often denounced as of doubtful expediency, of precarious character, or even of wasteful and destructive tendency. A judicious estimate of its fitness for Scotland—and, by parity of principle, for the

north of England and the north of Ireland—is made, in the following terms, by Mr. Lawson:—“ Much has been said and written recommendatory of the cabbage tribe being more extensively subjected to field culture in this country, for feeding cattle, sheep, swine, and even poultry; but, judging from any trials which have been made, as well as from the natural habits of the whole tribe, their culture seems only likely to be attended with any chance of decided advantage on the most superior class of soils, particularly on such as are of rather strong texture, and where an abundant supply of manure can be had; and even in many such cases, it is questionable how far they ought to be preferred to turnips, over which, however, they possess the advantage of improving rather than deteriorating the quality of the milk of cows fed upon them, and also of growing freely on lands which are too stiff in texture for the growth of any sort of turnips.” A crop of open-headed cabbages has also the advantage of being easily accessible during frost and snow; and a crop of any kind of cabbages is almost certain to be more valuable than an average crop of turnips, under the present system of turnip-culture in the south and centre of England. Cabbage-culture on the whole, however, requires an unusual combination of warmth and moisture, incurs much risk from drought and insects, and is both exhausting to the soil and drastic upon the farmer's capital; and, in consequence, it continues to be quite unknown in the field-husbandry of many districts of Great Britain, and, except in comparatively rare instances, is not conducted upon an extensive scale in any. Yet Arthur Young, in his survey of Suffolk, says, that “ he has seen from 40 to 70 acres of cabbages on a farm, every year, for several years;” and Mr. Marshall, in his *Rural Economy of the Midland Counties*, says, “ Among the ram-breeders of Leicestershire, cabbages may be said to be already established as a prevalent crop, and there is one man within this district who has grown ten, twelve, or fourteen acres a-year, for many years past.” One reason why cabbages have acquired the reputation of being a very exhausting crop, is the censurable practice of leaving the roots and a considerable portion of the stems for a considerable time in the ground, and of therefore allowing them to throw out sprouts, and to rob the soil of a large portion of its most nourishing juices; and another reason is the equally censurable practice of permitting some of the open-headed kinds to run up into flower-stems, and in consequence to act most impoverishingly upon the soil. Cabbages are much relished by cattle; and, when used with some good hay, either for stall-feeding or for the dairy, they are found to be very decidedly nutritious, wholesome, and economical. They are better liked than turnips by hogs, and are well adapted to the rearing of calves and the feeding of broken-

mouthed sheep and cattle. According to Mr. Sinclair's analyses, one pound of drumhead cabbage contains 430 grains of nutritive matter and 280 grains of fibre, one pound of early York cabbage contains 430 grains of nutritive matter and 312 grains of fibre, one pound of purple borecole contains 448 grains of nutritive matter and 1,120 grains of fibre, and one pound of Kohl-rabi contains 251 grains of nutritive matter and 360 grains of fibre; and the average amount of the nutritive matter of cabbages is superior to that of common turnips in the proportion of 215 to 160, and inferior to that of Swedish turnips in the proportion of 215 to 220.

Single cabbages are frequently obtained of so great size as to weigh thirty or even forty pounds; but the average cabbages of a crop, even on the best soil and under the best culture, can rarely be produced of one-third of that size. If an average of twenty pounds could be obtained, and a space of one square yard were assigned to each plant, and no blanks to occur from careless planting, bad culture, or the attacks of disease, the produce per acre would amount to the magnificent figure of forty-three tons; but the actual average produce amounts in common estimation to only thirty tons, and probably amounts, in most circumstances, to not more than twenty tons.—When cabbages are removed late in autumn, or early in summer, the valuation for them, at the quitting of a farm, is the same as for turnips drawn and consumed elsewhere than upon the field; but when they are allowed to remain so long as to rob the land of a portion of its sustenance, they suffer a deduction according to the discretion of the valuers.—A method of cultivating cabbages as a joint crop with beans, is noticed in our article on BEANS.

Cabbages are subject to the same diseases as turnips, both from the attacks of insects upon the young plants, and from the formation of anbury in the roots; and they are subject, in their advanced state, to a fearful amount of devastation from the caterpillars of two species of butterflies. See the articles TURNIP-FLY, ANBURY, and BUTTERFLY. A disease in the roots of cabbages, known to all cultivators under the name of clubbing, is occasioned by the deposition of the eggs of an insect at the junction-joint of the roots and the stem. The organization is damaged, the flow of the sap is partially arrested, the bottom of the stem swells, and the plant becomes sickly, and cannot grow to maturity. This disease occurs principally on ground which has been frequently cropped with cabbages; and seldom or but mildly makes its appearance on land which is cropped with a many-membered rotation. One preventive or cure of it is to mix the top-soil with a half-inch stratum of charcoal dust; another is to apply quicklime and withhold manure; a third is to trench the land, and expose it in ridges to the frosts of winter; and a fourth and most effectual is to combine the last of these

with a succession of two or three years cropping of totally different vegetables. Ducks and other fowls afford good assistance in clearing the ground of slugs; and hand-picking must be practised for taking away caterpillars.

Cabbage-seed is so exceedingly liable to be affected by natural hybridization that the saving of any specimen of it, perfectly true to its sub-variety, is a work of some nicety. The usual method is to select a few fine plants, and to transplant them to the head in some spot as remote as possible from all other plants of the brassica genus; and this method is sometimes modified by selecting for them the centre of a field of wheat or some very similarly situated spot.—The seed retains its vegetative power for three or more years; yet the seed of the immediately preceding season ought always to be preferred; and whenever seed of even two years old is used, it ought to be tested by a specimen-sowing of it in a flower pot, exposed to very genial heat. A failure of the seed-bed may occasion a serious loss of time, and ought to be carefully prevented. An ounce of seed sown broadcast is sufficient for a seed-bed of forty square feet; and less is sufficient, when sown in drills, six or seven inches asunder. Half a pound of seed will produce more plants than can be grown upon an acre.

When cabbages are given to milk-cows, all leaves which are not perfectly sound ought to be carefully stripped off, and appropriated to pigs or to store cattle. When cabbages are given to sheep or cattle, they ought to be sliced in the same manner as beet-root or turnips; and when given for fattening bullocks, they ought to be combined with oil-cake. A proper method of giving them sliced to sheep, is in troughs either on the field in which the cabbages grow, or on any grass-land which requires to be manured with the sheep's droppings. When bolled-headed cabbages cannot all be successionally used before the commencement of winter, the portion which remains on the field must be gathered at one harvesting, and may be stored somewhat in the manner of turnips, but they cannot be long preserved from destructive fermentation. The very extensive use which is made of cabbages in the preparation of a peculiar salted vegetable food by the Germans, will be separately noticed. See the article SAUER-KRAUT.—*Don's Dictionary of Botany*.—*Dr. Neill's Fruit, Flower, and Kitchen Garden*.—*Horticultural Magazine*.—*Baxter's Agriculture*.—*Marshall's Midland Counties*.—*Marshall's West of Englanâ*.—*Quarterly Journal of Agriculture*.—*Lawson's Agriculturist's Manual*.—*Catalogue of the Highland Society's Museum*.—*Journal of the Royal Agricultural Society*.—*Magazine of Domestic Economy*.—*Doyle's Husbandry*.—*Bayldon on Rents and Tillages*.—*Loudon's Works*.—*Randall's Semi-Virgilian Husbandry*.—*Sproule's Agriculture*.—*Low's Agriculture*.—*Gardener's Magazine*.—*Miller's Dictionary*.—*British Husbandry*.—*Rham*.—*Young*.—*Mawe*.

CABBAGE-TREE, botanically *Areca*. A genus of deciduous tropical trees, of the palm tribe. The medicinal or catechu species, *Areca catechu*, grows naturally in the East Indies, and was introduced thence to the hothouses of Great Britain toward the close of the 17th century. It usually attains a height of about 30 feet; and has somewhat the appearance of a gigantic specimen of the cow cabbage. Its timber is used in India for roofing-rafters and similar purposes. Its nuts, when very young and tender, are used as a chief ingredient in a decoction which is prescribed for costiveness consequent on dyspepsia; and, when full grown, they are chewed with the betel leaf. The spatha, or tough, fibrous, vegetable covering of the nuts is manufactured by the Hindoos into caps, small umbrellas, dishes, buckets, and vessels for holding water and arrack; and the inside part of it readily separates from the outside part, and has an appearance like fine white China paper, and can be written upon with ink.—The oleraceous species, *Areca oleracea*, grows 40 or 45 feet high, and is cultivated in India for the culinary use of its produce.—The dwarf species, *Areca humilis*, grows to the height of about six feet, and is also cultivated in India. Seven other species, the red, the slender, the Manicot, the triandrous, the mountain, the lutescent, and the hairy-coated, have been introduced to the hothouses of Britain,—three from the Isle of France, two from South America, and two from respectively the East and the West Indies; and all these seven have an ornamental character. Several other species are known to botanists. The name of cabbage-tree is also sometimes given to the cow-cabbage and to the Klein's species of cacalia.

CACALIA. A genus of plants, of the groundsel division of the composite family. Their name means 'exceedingly evil,' and alludes to their powerfully detrimental action upon the soil. Upwards of thirty species have been introduced to the gardens of Britain, from both the old world and the new, and from both the southern hemisphere and the northern; and about thirty other species have been scientifically described. Nearly one-half of the introduced species are evergreen undershrubs, four are evergreen herbs, one is an evergreen creeper, two are tuberous-rooted perennials, three are annuals, and most of the others are deciduous, herbaceous perennials. Most are curious and interesting; and about one-third are beautiful. We shall briefly notice two or three as specimens of the whole.

The alpine species, *Calcilia alpina*, is a hardy, perennial-rooted, herbaceous, ornamental plant, of the mountains of Austria and Switzerland, and was introduced to Britain in the former half of last century. Its root is fleshy and spreading; its leaves rise in profusion from the crown of the root, each standing on a single footstalk, and shaped like the leaf of ground-ivy, but thicker in texture, white on their under-surface,

and shining-green on their upper surface; its stem rises from among the leaves, and is round, branching at the top, and about two feet high; its flowers grow in a kind of umbels at the ends of the branches, have a purplish colour, and appear in July and August; and its seeds are oblong and crowned with down.—Klein's species, *Cacalia Kleinia*, grows naturally in the Canary Islands, and was introduced to Britain in 1732. Its stem is thick, fleshy, jointed, swollen in the middle of the spaces between the joints, irregularly but profusely ramified, and usually from three to nine feet high; its branches have the same jointed and bearded appearance as the stem; its leaves grow irregularly all round the extreme part of the branches, and are glaucous in colour, and long, narrow, spear-shaped in form, —and when they fall off, they leave scars which always remain on the branches; and its flowers grow in large clusters at the extremity of the branches, and are tubulous and of a faint carnation-colour, and bloom in September and October. "This plant," says Miller, "has been called cabbage-tree by the gardeners, from the resemblance of its stalks to those of the cabbage; by others, carnation-tree, from the shape of the leaves and colour of the flowers. There have been stones and fossils dug up at a great depth in some parts of England, which have very perfect impressions of this plant upon them; from whence Dr. Woodward has supposed the plants were lodged there at the universal deluge; and finding the impressions of many other plants and animals, which are natives of those islands (the Canaries), he concludes that the waters flowed hither from the south-west." This species is propagated from cuttings, and requires greenhouse protection in winter, and a warm, dry, airy situation in summer, and evinces great impatience of any considerable quantity of water.—The sow-thistle-leaved species, *Cacalia sonchifolia*, is a tender ornamental annual from the East Indies, and was introduced in the latter part of last century. Its stem attains a height of about 18 inches; and its flower has a purplish or orange-red colour, and appears in July. The scarlet-flowered species, *Cacalia coccinea*, is a hardy annual, of 18 inches in height, and blooms in June and July.

CACAO,—botanically *Theobroma Cacao*. A cultivated, evergreen, nuciferous, tropical tree, of the Byttneria tribe. It is usually but very improperly termed in Britain cocoa; and it furnishes the well known cocoa and chocolate of our tea-shops. It grows naturally, in great abundance, in the Caraccas, in Guayaquil, in the isthmus of Darien, in the Honduras, in Gauthimala, in Nicaragua, in the valley of the Amazon, and in several other parts of tropical America; it is extensively cultivated, for the sake of its nuts, in some of these districts, and in some of the islands of the West Indies; and, since 1739, it has been grown and kept as a curiosity in

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some of the hothouses of Great Britain. The cultivated trees seldom attain a height of more than 16 feet, and are usually grown in deep and narrow valleys, or between rows of sheltering plantain-trees, or in some other kind of densely shaded and thoroughly sheltered situation. The buds for the flowers and fruit do not, as in most other trees, come out at the extremities or on the young shoots of branches, but are produced on the larger branches and on the stem. The tree presents some resemblance, in both size and shape, to a young blackheart cherry; and the fruit is a large pod, shaped somewhat like a cucumber, and containing from twenty to thirty well-packed nuts about the size of large almonds. Trees of from three to eight years old yield about 55 or 60 pods in the year, and full-grown trees yield about 200 or 240. The pod is easily ascertained to be ripe by its becoming yellow on the side next the sun. The shell of the nut is thin, brittle, and dark brown; and the kernel is brownish all through, and has a light pleasant odour, and an unctuous, roughish, bitterish but not disagreeable taste. The nuts yield, by expression, a large quantity of oil; but they are cultivated solely for the sake of their cocoa husks and shells, and of the manufacture of their whole substance into chocolate.

"In gathering the fruit," we are told, "they generally place a negro to each row of trees; who, being furnished with a basket, goes from tree to tree, and cuts off all those pods which are ripe, leaving the others a longer time to ripen. When the basket is full, he carries the fruit, and lays it in a heap at one end of the plantation; where, after they have gathered the whole plantation, they cut the pods lengthwise, and take out all the nuts, being careful to divest them of the pulp which closely adheres to them; and then they carry them to the house, where they lay them in large casks, or other vessels of wood, raised above the ground, and cover them with leaves of the Indian reed and mats, upon which they lay some boards, putting some stones thereon to keep them down close, in order to press the nuts. In these vessels, the nuts are kept four or five days; during which time, they must be stirred and turned every morning, otherwise they will be in danger of perishing from their great fermentation. In this time, they change from white to a dark red or brown colour. Without this fermentation, the nuts will not keep, but will sprout if they are in a damp place, or shrivel and dry too much if exposed to heat. After the nuts have been thus fermented, they should be taken out of the vessels, and spread on coarse cloths, and exposed to the sun and wind; but at night or in rainy weather, they must be taken under shelter, otherwise the damp will spoil them. If the weather proves fair, three days will be long enough to dry them, provided they are carefully turned from time to time, that they may dry equally on every side."

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The best cacao nuts of commerce are plump, shining, and quite free from mustiness or any symptoms of decay. The cacao of the Caraccas is the most abundant in the European markets, and brings, on the average, about one-third higher price than the cacao of Guayaquil; but the best, in price and reputation, is that from Socomusco. Cacao plantations were, at one time, extensive in Jamaica, but were destroyed by the effect of excessive taxation in Britain upon their imported produce; and even the cacao plantations of the Caraccas have, of late, been considerably diminished by the encroachments of cotton, coffee, or sugar-cane cultivation. A large proportion of the cacao husks and shells met with in Great Britain is the refuse of the chocolate-manufactories of Gibraltar and other places; and a considerable proportion of the chocolate of our shops is a vile compound of flour and soap.

Plants of *Theobroma cacao* can be raised in Great Britain from cuttings in rich mould; but all plants of it for our hothouses were formerly imported from their native country in a seedling condition in pots. They require great nicety of management, frequent waterings, occasional cleanings, and yet constant comparative dryness; and they cannot, without great difficulty, be brought to fruit.—Two other species of cacao-tree, *Theobroma bicolor* and *Theobroma guianensis*, have been introduced to our hothouses since the commencement of the present century,—the former from New Granada, where it is cultivated, and the latter from Guiana.

CACHRYS. A genus of hardy, herbaceous, perennial-rooted plants, of the umbelliferous family. Several species which formerly belonged to it are now dispersed under four other genera; but ten species still belonging to it have been introduced to Britain; and about half a dozen others are known to botanists. The introduced species are natives of Siberia, Tauria, Caucasus, the south of Europe, and the Levant; most have a height of about 12 or 18 inches, and produce yellow or white flowers in July and August; and several possess a considerable resemblance to one or other of the fennel plants. The roots of most strike deep into loose soil, and are often as large as parsnips; and those of one species are eaten, in seasons of scarcity, by the inhabitants of Serbia, Transylvania, and the adjacent countries.

CACTUS. A genus of succulent, evergreen, grotesque-looking plants, forming the type of the natural order Cactæ or Opuntiaceæ. This order, at a comparatively recent period, comprised few known plants, and was identical with a single genus; and, though now prodigiously enlarged, and comprising multitudes of known plants, and at least nine distinct genera, it is still very generally called, not Cactæ, but Cactus. Its genera are cactus, opuntia, mammillaria, cereus, epiphyllum, pereskia, melocactus, echinocactus, and rhipsalis; and all of these, except the last, may be regarded as having for their type the genus

opuntia. Only four or five species—and these not at all of striking character—have been permitted to remain with the genus cactus; so that all the most remarkable cacti of the nurseries must now be sought for under some of the other genera, particularly opuntia, cereus, epiphyllum, mammillaria, melocactus, and echinocactus. The number of species at present cultivated in the greenhouses and hothouses of Britain is about one hundred and sixty.

The cacti seem most closely allied, in habit and general character, to the orders Ficoideæ and Crassulaceæ; and yet—in spite of an utter dissimilarity in structure and mode of subsistence—they are generally regarded as most nearly akin to Grossulaceæ or the gooseberry-tribe. Their flowers, in many instances, are large, beautiful, and most imposing; the sepals have a segmented and overlapping border, and shade off from greenness and leafiness to brilliant tinting and delicate texture; the petals emerge by insensible gradations from the sepals, and are very numerous, and often not a little gorgeous,—varying from pure white to rich scarlet and purple, and passing through all the intermediate shades of colour; and the stamens are multitudinous and aggregately beautiful, and consist of slender and delicate filaments, surmounted by small roundish anthers. The fruit is a succulent, fleshy, watery berry, somewhat similar to the gooseberry, having at the end a broad scar, and containing numerous succulent seeds and a poorly flavoured or quite insipid juice, yet greedily eaten, in the native countries of the cacti, for the sake of its refreshing coolness and moisture. The structure of the fruit and the general spininess of the plants are the features which assimilate the cacti to the grossulaceæ.

But by far the most remarkable characters of the cacti are their pervading succulence, their general leaflessness, their poverty in stomata or perspiring pores, their profuse prickliness and hairiness of surface, their grotesqueness and metamorphosis of structure, and their powerful fondness for aridity of situation. The stem of the opuntias is much compressed, that of the epiphyllums is somewhat leafy, that of the other genera is angular or deeply channelled, that of very many of the species is regularly jointed, and that of the whole order is exceedingly succulent, and contains but a small amount of woody matter proportionally to its whole mass. But as the plants advance in age, a metamorphosis gradually occurs in their stems, obliterating their angles, furrows, and compressions, and converting them into almost perfectly cylindrical trunks; and this metamorphosis has occasioned much confusion in the description of not a few of the species, and still prevents portions of the order from assuming a fixed systematic arrangement. Some, as the whole of the melocacti and echinocacti, have a spherical shape, and seldom grow higher than a few inches; many of even other shapes, as most

of the mammillarias, rarely grow higher than half a foot; the great majority of the other genera have an upright growth of from 18 inches to 6 feet; two, *Opuntia spinosissima* and *Cereus repandus*, have usually a height of about 20 feet; and one, *Cereus hexagonus*, commonly attains the enormous height of 35 or 40 feet. The multitudes of small species creep among the sands and rocks and dry forest-grounds of their native countries in so vast profusion and with such blood-spilling gripes as to render travelling amongst them difficult and lacerating; and the few tall species lift their gaunt, grotesque, angular, leafless, spine-armed stems far above the surrounding stunted vegetation, and form a bizarre and rueful feature of a sterile and sun-scorched landscape.

The cacti occur in greatest profusion within the tropical parts of America; and, till quite a recent period, were supposed to extend very slightly or not at all within the temperate latitudes. But from the immediate vicinity of the city of Mendoza in South America, situated in 30° of southern latitude, Dr. Gillies has sent to the botanic gardens of Britain no fewer than twenty-two species; and in the North American region of the Rocky Mountains, between 30° and 40° of northern latitude, Messrs. Douglas and Drummond saw many cacti. The common opuntia, however—*Opuntia vulgaris*, formerly called *Cactus opuntia*—has for centuries been naturalized in the south of Europe, particularly in Spain and Sicily; and was introduced thence to Great Britain so long ago as toward the close of the 16th century.

The cacti abound chiefly on hot dry sandy plains, or hot dry rocky districts where plants of a less succulent or more perspiring nature could not exist; and they serve both to afford cooling nutriment to man in regions where drink and ordinary food cannot be obtained, and to produce a vegetable soil on surfaces which, but for their growth and decay, would for ever remain arid wastes. They possess a singularly tough epidermis, and have very few and merely rudimentary stomata; and, in consequence, are enabled to retain for a long period such moisture as they can collect from rains and dews, and to sustain unhurt the full play of the unclouded tropical sun, and the ardent radiation of his calorific rays from the surrounding sands and rocks. The common opuntia easily inserts its roots in the cracks and crevices of the volcanic rocks of Sicily, and readily propagates itself over expanses of volcanic sands and ashes where not a particle of humus exists; and it has eventually disspread itself over the entire surface of many a naked hill, and either formed, or is in the process of forming, a sufficient depth of vegetable mould by its decay to sustain the most useful forms of vegetation. Several of the opuntias are selected by the Spanish Americans, on account of their rapid growth and their spinous armature, for the formation of fences around fields and dwellings; and they

speedily elongate and amass themselves into such powerful enclosures as neither man nor beast can penetrate. Numerous species of opuntia are fed upon by the cochineal insect, in both a natural and a cultivated condition; all the species with red flowers appearing to be relished by its own taste, and the species which are least spiny being cultivated for its use in Peru and Mexico; yet a species to which botanists have given distinctively the name of *Opuntia cochinillifera*, probably affords less food to the insect than any one of several other species. The insipid juice with which the stems of most of the cacti abound is a grateful nutriment to the inhabitants of many parts of the American tropics; and the fruit of a considerable number of species is, in these districts, as much relished for dessert as the gooseberry is in Europe, and is profusely used in cooling drinks for fevers, and is occasionally employed as an external application for the cure of ulcers, and, in some instances, constitutes a bulky and essential article of daily food. The common opuntia covers the hills of Palermo, and produces its crops of fruit for the Sicilians, in nearly the same manner in which some of the most valuable esculents cover the choicest fields of our farms, and produce daily nutriment to Britain. "The cactus," we are told, "was probably introduced into Sicily by the Spaniards. It forms as important an article of diet with the inhabitants of that island as the potato does with ourselves. This abundant, cooling, and juicy fruit forms the principal food of the lower classes for three months, and is considered very palatable, although strangers usually find it insipid." The chief of the other species which are most valued for their fruit are *Cereus multangularis*, a plant of South America, seldom attaining a height of more than 9 or 10 inches; *Cereus Peruvianus*, a red-flowered plant of Peru, usually about a yard high; *Cereus triangularis*, a white-flowered plant of the West Indies, usually about a foot high; *Cereus Royeni*, a white-flowered plant of South America, usually about two feet high; *Cereus lanuginosus*, a white-flowered plant of the West Indies, usually about a foot high; *Cereus repandus*, a gigantic white-flowered cactus of the West Indies, usually about twenty feet high; *Pereskia aculeata*, a white-flowered plant of the West Indies, usually about five feet high; *Pereskia grandifolia*, a Brazilian plant, about a yard high; *Pereskia longispina*, a South American plant, about four feet high; *Pereskia portulacæfolia*, a West Indian plant, usually about a yard high; *Pereskia Bleo*, a rose-coloured flowering plant of Mexico, usually about five feet high; and *Cereus speciosissimus*, a crimson-flowered plant of South America, usually about a yard high, and producing even in the hothouses of Britain a fruit as large as a hen's egg, with a very rich and agreeable smell, resembling that of a pine apple.

The cacti are very extensively cultivated in almost all our hothouses; and they form a chief

glory of our flower-stages in several months of spring and summer. Many of them, with their large brilliant flowers, some crimson, some pink, some blush, some snowy-white, and others of many intermediate colours, are most beautifully dazzling; and several—especially *Cereus speciosissimus*, *Cereus grandiflorus*, *Cereus flagelliformis*, *Cereus Colvilli*, *Cereus triangularis*, *Cereus setosus*, *Cereus splendidus*, *Cereus Napoleonis*, *Cereus Malisoni*, *Epiphyllum speciosum*, *Epiphyllum spec. lateritia*, *Epiphyllum spec. Jenkinsoni*, and *Epiphyllum Ackermannii*, rank among the most gorgeous floral productions in the world.

The method of cultivating the cacti with the view of obtaining the finest blooms, is to imitate, as nearly as possible, their natural treatment on the arid soils, under the scorching sunshine, and with the alternation of rainy season and long drought of their native countries. A cactus is potted among mere rubbish, placed in a damp stove, and exposed to the fullest and strongest play of natural light, till it begins to grow; it is then watered throughout the period of about three months, at first poorly and sparingly, but afterwards manurially and copiously; it is then gradually abandoned to draught, aridity, and a lowering of temperature, but with continued exposure to the full play of light, till it sinks to repose; and it is then allowed to remain in arid and neglected sleep till the next season arrive for watering and heating it into activity and growth. Yet a writer in the Gardener's Magazine, who always got *Epiphyllum speciosum* and *Cereus speciosissimus*, not only to flower well, but to fruit freely, describes the following as his method:—"The compost is loam and peat, with a little lime rubbish. We grow them in the stove until they get a pretty good size, or until we want them to flower, for they will flower at any age or size. In the month of June or July, we turn them out of doors into a warm sheltered situation, and perfectly exposed to the mid-day sun; and there they remain until we take in our tender greenhouse plants, when we remove them to a shelf, or any situation, in the greenhouse for the winter. In the spring, we remove them into the stove or forcing-house in succession, as we wish them to come into flower. They will flower in the greenhouse; but the flowers are small, and the growth but slow, in comparison to those that are removed into a higher temperature. Their flowering depends, like most other things that flower upon their wood made the preceding year, upon its being well ripened and matured in the sun and air, and kept perfectly free from shade."

The genera *Opuntia*, *Epiphyllum*, *Rhipsalis*, *Pereskia*, and the greater portion of *Cereus*, are propagated from cuttings; and the genera *Cactus*, *Melocactus*, *Echinocactus*, *Mammillaria*, and the smaller portion of *Cereus*, are propagated from offsets. Branches and joints, cut away from such species as possess them, dried a little

in the sunshine, and then stuck in proper rubbishy soil in a moist and hot place, immediately and most facily strike root; and hence the perfect ease and most cheap convenience with which all the elongated kinds can be diffused over arid wastes in warm countries. The offsets of the spherical-stemmed kinds are produced, by forced development of some of the little tufts of spines which grow on the angles of their ridges, and which organically possess the character of buds or rudimentary branches. If the plant have its top either cut off with a knife or burned with a broad flat iron, small branches are developed from several of the spiny tufts; and these, when broken off and treated similarly to the cuttings of the other kinds, easily and rapidly strike root.

CADAMBA,—botanically *Nauclea Cadamba*. An evergreen East-Indian tree, of the madder tribe. It has an ornamental appearance, carries orange-coloured flowers, and usually attains a height of about 20 feet. The timber of it is very beautiful for furniture; and is sometimes, but not often, imported into the southern provinces of continental India from Ceylon.

CADMA. The smallest individual in a litter of pigs. In almost every litter, one pig is very perceptibly smaller than any of the others; and this is the cadma.

CADMIUM. A metal discovered in 1817, and hitherto regarded as a simple or undecomposable substance. It is usually found in combination with zinc, but occurs in very inconsiderable quantity. It resembles tin in both colour and lustre, but is rather harder and more tenacious; it is very ductile and malleable; it has, in its unhammered state, a specific gravity of 8.604; it melts at about the same temperature as tin; it is nearly as volatile as mercury; and, when in the state of vapour, it has no odour, and condenses into globules which have a metallic lustre. The principal combinations of it with other elements are an oxide, a sulphuret, and a chloride.

CÆCUM. The first or uppermost of the three large intestines. It is a large blind pouch, amply provided with blood-vessels and absorbents, receiving the excess of watery matter which escapes from the stomach and passes unappropriated through the small intestines, and retaining this during a comparatively long time for the processes of absorption or uses of the system, and, in consequence, acting as a kind of water-stomach. The cæcum of the horse holds about four gallons, and retains a most valuable supply of his copious but unfrequent drinks for the wants of his system while he toils undrinkingly in the yoke, or digests his dry food in the stall. The cæcum of the ox is much less retentive than that of the horse, and is adapted to the wants of an animal whose principal food is bulky and succulent.

CÆSALPINIA. A genus of tropical evergreen shrubs and trees, of the cassia division of

the leguminous tribe. About twenty species have been introduced to the hothouses of Britain, from the East Indies, the West Indies, Mexico, and Brazil; and about a dozen other species have been scientifically described. The stems of all are arborescent and more or less prickly; their leaves are abruptly pinnated; and their flowers are showy, and for the most part yellow, but in some instances inclining to orange and white. One of the introduced species, *C. scandens*, is a climber of about 20 feet in height; and the others are arborescent shrubs and trees, varying in height from 6 to 30 feet. Two introduced species from the West Indies, *C. brasiliensis* and *C. crista*, and one introduced species from Brazil, *C. echinata*, yield most of the beautiful Brazil-wood of commerce. See the article BRAZIL-WOOD. An introduced species from the East Indies, *C. Sappan*, yields a valuable red dye-wood to the inhabitants of Hindostan and Sumatra. An un-introduced species in India, *C. pulcherrima*, derives its specific name of 'most beautiful' from the supposed resemblance of its flower to the tail of a peacock. And an un-introduced species in Curacao and Carthage, called popularly Divi-divi, and scientifically *C. coriaria*, produces pods which are remarkably rich in tannin, and are used by the natives of Curacao and Carthage for making leather, and might advantageously be imported to Britain as a substitute for oak bark and nut galls. The soluble matter of the pods is comparatively large in quantity, and possesses so great an affinity for water, and yields itself thence so readily to hides, that the rude leather of Curacao and Carthage is manufactured by means of it in the brief space of two days. The per-centage of tannin in these pods is 51.168, in nut-galls 35.458, and in oak-bark 13.417; and the proportion of 60 grains of the pods soluble in 5 ounces of water is 45.75, of nut-galls 35.5, and of oak-bark 18.

CÆSARIAN OPERATION. The artificial extraction of a foetus, by opening the side of the mother. This operation has been occasionally performed on cows, but very rarely with the effect of saving the life of either the cow or the calf. It is never justifiable except when, from large hard tumour in the womb or any similar obstruction, natural parturition is absolutely impossible; and it can be attempted only by a very experienced veterinary surgeon, who, of course, understands its nature better than could be expressed by any brief description of ours.

CAFFEIN. The peculiar chemical principle of coffee. It was obtained in a separate state, first in 1820 by Runge, and very soon after by Pelletier and Caventon. When obtained by the cooling of a strong solution, it forms slender, flexible, opaque, silky, filamentous crystals resembling amianthus; but when obtained by slow spontaneous evaporation, it forms long, fine, transparent, and but slightly flexible prisms. It is volatile, and has a slightly bitter and dis-

agreeable taste. It consists of 8 equivalents of carbon, 5 of hydrogen, 2 of nitrogen, and 2 of oxygen; yet though containing a larger proportion of nitrogen than occurs in most animal substances, it is not subject, under any circumstances, to the putrefactive fermentation. In 100 parts of Martinique coffee, the quantity of caffein, according to Robiquet, is 6.4; in Java coffee, 4.4; in Mocha coffee, 4; in St. Domingo coffee, 3.2.—Another proximate element of coffee is caffeic acid. This is obtained in the form of brown translucent scales; it has the aromatic odour of burnt coffee; and it consists of 29.1 per cent. of carbon, 6.9 of hydrogen, and 6.4 of oxygen.—A concentrated preparation of coffee figures in the pharmacy of the new homœopathic school.

CAGE-GATE. A small gate traversing between two shutting-posts, and subtended by a small angular space enclosed with paling. It is comparatively expensive in construction; yet it is specially convenient for the transit of infirm or careless persons, as it cannot be so left open as to permit the passage of a cow or sheep.

CAHUCHU. See CAOUTCHOUC.

CAINITO,—botanically *Chrysophyllum Cainito*. A species of evergreen West-Indian and South-American fruit-tree, of the star-apple genus, and sapota tribe. Four varieties of it exist in the hothouses of Britain, the normal kind, the Jamaica variety, the blue-fruited, and the small-leaved; and the first usually attains a height of 50 feet, the second and the third 40 feet, and the fourth 30 feet. Their branches are numerous and slender; their leaves are spear-shaped, their upper-surface deep green, and their under-surface shining like satin; their flowers have a white colour, are produced in bunches from the wings of the leaves and the extremity of the branches; and their fruit is round, pulpy, and about the size of a golden pippin,—at first very rough and astringent, but afterwards becoming mellow like the medlar. Their timber is used in buildings, and for shingles to cover houses.

CAIRN. A heap of stones thrown together in a conical form. Cairns seem to differ from barrows, only in regard to the materials of which they are composed: they both seem to have been designed for the same purposes; and accidental circumstances directed the one to be constructed of stones, and the other of accumulated earth. In Scotland and Wales, cairns are more common, because the materials are everywhere to be found in abundance. In England, barrows are more frequent, because stones are not so easily procured for the construction of these monuments. It is in vain that we attempt to trace the history of cairns, or to deduce their origin from any particular nation; they evidently originate in principles common to human nature, and were the first rude monuments of events which men were desirous to commemorate. Wherever we read of a pillar or a stone set up as "a memorial," we see the origin of the cairn, and the principle

which gave rise to its construction, Gen. xxi. 46; Josh. iv. 5. The durability of the substances of which these monuments were composed, recommended them as memorials to more polished ages, and the splendid pillar and stupendous pyramid are only improvements and extensions of this simple structure. The Israelites raised a great heap of stones on the body of Achan, as a monument of perpetual infamy, Josh. vii. 26; and they also raised a heap of stones to celebrate their miraculous passage over the river Jordan. In the same manner, cairns are sometimes raised in Scotland to this day, in places where murders or suicides are committed; and there can be no doubt that many of the ancient cairns are designed to celebrate events of more propitious omen.

As religion, however, even in the rudest states of society, has always deeply interested the feelings of men, we may naturally expect numerous monuments relating to this important subject. Connected with religion is the sepulture of the dead, an object of great importance in the estimation both of civilized and barbarous nations; and there can be no doubt that the cairns in Britain and Ireland have often been consecrated to both these purposes. Some antiquarians have supposed the cairns to be relics of Druidical superstition, and originally dedicated to the worship of the Sun; whilst others have contended that they are to be considered merely as funeral monuments. The first opinion derives some support from a practice common in former times, of going round these cairns at particular periods, according to the course of the sun, when a favourable issue was desired to any event or undertaking; and of moving in an opposite direction when vengeance and imprecations were denounced against obnoxious individuals. The second opinion derives confirmation from the circumstance of urns and bones being generally found under these monuments. But the two opinions are not at all inconsistent. The place consecrated to religious uses would naturally be considered as the most proper receptacle for the sacred reliques of the dead; whilst, on the other hand, the feelings which arise from contemplating the remains of our relations and friends, dispose the mind to devotion, and fit the place which contains them for the hallowed purposes of religion.

CAJANUS. A small genus of tender culinary plants, of the French-bean division of the leguminous tribe. The plants, according to circumstances, are annual, biennial, or slightly perennial; they have a height of from 18 inches to 4 feet; they bloom in July and August; and they are cultivated for the sake of their seeds in both the East and the West Indies. Only two species are known, *C. bicolor* and *C. flarus*; and the former was called *Cytisus pseudo-cajan* by Jacquin, and the latter *Cytisus cajan* by Linnæus. The one species has its flowers streaked with crimson, and its pods marbled with dark streaks, and con-

taining each four or five seeds; and the other has its flowers wholly yellow, and its pods quite unspotted, and containing each two or three seeds. Both species are called Pigeon-Pea in the East Indies; and the two are called respectively Cougo-Pea and No-eye Pea in the West Indies. Dr. MacFadyen, in his 'Flora of Jamaica,' says, "The general appearance of both is very much alike; and they can scarcely, previous to flowering, be distinguished from one another, except that the leaves of *C. flarus* are rather smaller and finer to the touch. Of these two species, the No-eye pea is the most delicate, being in the green state very little inferior to the English pea, and, when dried and the cuticle removed, equal to the split peas we receive from Europe. The other species is coarser, and made use of principally by the negroes, and requires in the dried state a tedious boiling process before the seeds can be softened. From the two species being frequently, through carelessness, planted close to one another, we may occasionally meet with hybrid varieties. When once established, they stand for several years. The leaves are annually shed, and are reproduced with the flowers in the early months of summer: the crop is gathered during the months of autumn. No particular care or trouble is required in the cultivation of these shrubs; and they thrive in the poorest land. They are said, indeed, to improve the ground on which they grow, by the decay of the leaves, which are annually shed in great profusion. There are very few tropical plants, indeed, so valuable. They are to be found round every cottage in the island, growing luxuriantly in the parched savannah and mountain declivity, as well as in the more fertile and seasonable districts." Though much too tender for British field culture, they might probably be found well worthy of introduction into several of the British colonies where they are at present unknown.

CAJEPUT (OIL OF). A volatile oil, obtained by distillation from the leaves of two species of evergreen myrtaceous trees, of the genus *melleuca*. Both species usually grow to the height of about 15 feet, and have an ornamental appearance, and were introduced about half a century ago to the hothouses of Britain. They are natives of the islands of Amboyna, Java, and Borneo, and bear the specific names of *leucadendron* and *cajuputi*, both signifying "a white tree," the former in the Greek language, and the latter in the Malay. Their bark is pale, rough, and lamellated; their leaves are alternate, lanceolate, entire, smooth, firm, fragile, of a pale yellowish green colour, agreeable in fragrance, and about three inches long; their flowers are white and sessile, and have minute ovate bracts; and their fruit is a three-celled capsule, containing many small, oblong, angular seeds. The oil is obtained by distillation from the fermented leaves; but it is procurable in very small quantity, and bears a high price. When newly drawn, it is limpid,

pellucid, and volatile, and has a very pleasant odour, similar to that of cardamoms but stronger; and, as sold in Britain, it shows a greenish colour from the copper vessels in which it is imported, and has an odour somewhat like that of camphor. It is often adulterated with other volatile oils and with oil of turpentine, and coloured with resin of milfoil. The genuine oil is a stimulant, antispasmodic and diaphoretic; it produces a sense of heat in the stomach, quickens the pulse, and causes a flow of perspiration; it is internally exhibited in cases of dropsy, palsy, colic, hysteria, chronic rheumatism, and various spasmodic and nervous affections; and it is externally applied, in dilution with olive oil, as an embrocation for rheumatism, gout, and enfeeblement from sprains. But all doses of it require to be very minute.

CAKILE. A small genus of hardy, ornamental, annual plants, of the cruciferous tribe. The sea-rocket species, *Cakile maritima*, abounds on the sandy sea-shores of many parts of Great Britain. Its stem and branches are very twisted and flexuous; its leaves are pinnatifid, obtuse, fleshy, and somewhat glaucous, and have a saltish bitter taste; its flowers are rather large, purplish or bright lilac, growing in dense corymbs, and blooming from June till September; its usual height is about 9 or 12 inches; and its general form is ramose, spreading, and bushy. The Egyptian and the American species have been introduced from respectively Egypt and America; and they are a little taller than the sea-rocket species, and produce purple flowers from June till August. The wrinkly and the perennial species are now assigned to the genus *rapistrum*.

CALABA,—botanically *Calophyllum calaba*. An Indian evergreen timber-tree, of the calophyllum genus, and guttiferous tribe. It usually attains a height of about 30 feet, and is distinguished by the beauty of its foliage. Some plants of it have, for sixty years past, been in Britain. Another species of calophyllum, *C. spurium*, has sometimes been called Calaba.

CALABASH-TREE,—botanically *Crescentia*. A small genus of curious evergreen trees, of the nightshade tribe. The cujete species, *Crescentia cujete*, was introduced to the hothouses of Britain from Jamaica toward the close of the 17th century. Its trunk is thick, and covered with a whitish bark, and usually attains a height of between 20 and 30 feet; its branches deflect in large numbers from the upper part of the trunk, spread out in every direction, and form a large and regular head; its leaves are nearly 6 inches long, about 1½ inch broad, and tapering at both ends,—they have a lucid green colour, and stand on very short footstalks,—and they come out irregularly, in some places singly, and in other places in groups; its flowers are greenish-white and monopetalous, and are produced on long footstalks from the side of the large branches, and sometimes from the trunk; and its fruit is

very large and of different shapes, often spherical, sometimes oval, and occasionally with a contracted neck and a distended body like a bottle. The fruit consists of a thin greenish-yellow cuticle or skin, a hard ligneous shell, and a pale yellowish soft pulp, of a tart unsavoury flavour, and containing a large number of flat heart-shaped seeds. The natives peel off the skin, and throw it away; they clean out the pulp, and either reject it as waste, or merely give it to cattle at times of great drought; and they dress up the ligneous shell, sometimes with handles, sometimes with silver mountings, sometimes with excision of parts, and sometimes with merely a coarse polishing, into a drinking-cup, a spoon, a ladle, a bottle, a jewel-case, or any one of some hundreds of other utensils. The Indians of both the North and the South Seas store the pearls of the pearl fisheries into calabashes; and the Africans use calabashes for keeping their gold-dust. The timber of the cujete calabash-tree is hard and smooth, and is often used for making saddles, stools, and other articles.—The gourd-fruited species, *Crescentia cucurbitina*, was introduced to Britain from the West Indies in the former part of the 18th century. It usually attains a height of about 15 feet, and has hard, white, and useful timber.—The acuminate species, *Crescentia acuminata*, was introduced from Cuba in 1822. It usually attains about the same height as the cujete species.—Four other species have been scientifically described, but have not yet been brought to Britain.

CALADENIA. A genus of beautiful, tuberous-rooted, greenhouse-plants, of the orchis tribe. The oldest-known species, *Caladenia alba*, was introduced to Great Britain from New Holland in 1810; and nine or ten other species have been introduced, from the same part of the world, during the last twenty-three years. They are very variously coloured in their flowers; they obtain their generic name, which signifies “a beautiful gland,” from the appearance of the disk of their labellum; and they constitute a fine accession to our very large and wondrous store of orchidaceous beauties.

CALADIUM. A genus of useful and ornamental tropical plants, of the tribe aroidæ. Its species present a somewhat close resemblance to some of those of the arum genus; and are frequently confounded with them by inexperienced botanists. The root of *Caladium esculentum* is in high repute, and extensively cultivated, in several oriental countries. It is shaped somewhat like the yam; and, when well boiled, and afterwards roasted, is not inferior to that esculent in flavour. It is the common food of the inhabitants of Travancore; and is there the produce of a superior variety of the plant, with broad, purple-coloured leaves. It grows to a large size in the country of the Worriahs, and is called by them cutchoo. It is held in high estimation by the Malays of the Indian archipelago. It grows abundantly in

marshy situations of Arabia; and is mentioned by Niebuhr under the name of *Arum esculentum*. A curious species, of about a foot in height, *C. lividum*, was brought to Britain a few years ago from the West Indies; a highly fragrant species, *C. fragrantissimum*, was brought a few years ago from Demerara; and a large-leaved species, *C. grandifolium*, was brought in 1803 from Demerara; but the esculent species of India and Arabia has not, so far as we know, been yet introduced.

CALAMAGROSTIS. A genus of grasses of the arundinaceous tribe. Its name indicates its plants to be reedy bents, and is sufficiently descriptive of their general character. The strict species, *C. stricta*, grows wild in the marshes of Scotland; and the terrestrial and lanceolate species, *C. epigejos* and *C. lanceolata*, grow wild in some moist places of both Scotland and England; but all these, as well as two species from Germany and Bohemia, were formerly classed, and are still sometimes classed, under the genus *arundo*. Two species from Germany, *C. sylvatica* and *C. speciosa*, were formerly, and are still sometimes assigned to the genus *agrostis*, the former as *Agrostis arundinacea*, and the latter as *Agrostis calamagrostis*. See the articles *AGROSTIS* and *ARUNDO*. About twenty species, inclusive of three indigenous ones, exist in Britain, and all are hardy, perennial, and unfit for cultivation as grasses; and ten or twelve other species have been scientifically described.

CALAMBOAC. See *ALOE-TREE*.

CALAMINE, or LAPIS CALAMINARIS. The impure carbonate of zinc. It is one of the chief native ores of zinc; and occurs, in considerable abundance, in the secondary limestone of Cumberland, Derbyshire, Flintshire, and Somersetshire. It is usually accompanied with other ores of zinc, and with galena, quartz, and calcareous spar; and, though used indiscriminately or treated as if uniform in composition, is commonly found of three varieties. According to analyses by Mr. Smithson, one variety consists of 65.2 per cent. of oxide of zinc and 34.8 of carbonic acid; another, of 64.8 of oxide of zinc, and 35.2 of carbonic acid; and the third, of 71.4 of oxide of zinc, 13.5 of carbonic acid, and 15.1 of water. But all the varieties, previous to being sent to the druggists, are usually deprived by calcination of a portion of their carbonic acid. Native calamine, in its general occurrence, has a greyish-yellow or reddish yellow colour, is amassed in friable, opaque, lustreless lumps, breaks with an irregular earthy fracture, and has a specific gravity varying from 3.584 to 4.334.

Prepared calamine occupies a place in all the British pharmacopœias, and also in the formulæ of cattle-medicine. The London and Dublin colleges direct it to be pulverized and levigated in the same manner as prepared chalk; and the Edinburgh college says, "Impure carbonate of zinc, roasted by those who make brass, being

rubbed to powder in an iron mortar, and levigated with a little water on a porphyry, is to be put into a large vessel, and water poured over it, which, after frequently agitating the vessel, is to be poured off loaded with the powder. The fine powder which subsides after the water has remained at rest, is then to be dried. The coarse, which the water cannot suspend, is to be again levigated, and treated as before." An ointment, made of this almost impalpable powder and hog's lard and wax, and long known under the name of Turner's Cerate, is the most healing application known for many kinds of sores, particularly for ulcers, for excoriations, for burns which have ceased to be inflamed, and for ophthalmia tarsi. This ointment has so great efficacy in veterinary practice as to be pretty commonly known under the name of "healing ointment;" and sometimes the dry prepared powder itself is very advantageously sprinkled on cracked heels and superficial sores.

CALAMINT,—botanically *Calamintha*. A genus of ornamental plants, of the labiate tribe. The common species, *Calamintha vulgaris*—called by Linnæus *Melissa calamintha*, and by Sowerby and Smith *Thymus calamintha*—is a perennial-rooted herbaceous plant, of about two feet in height, and grows wild at the base of hedges and on the borders of fields in England. Its leaves are roundish and dark-green; and its flowers are red-coloured, and appear in July and August. This plant has a strong, agreeable fragrance; and is said to possess the property of preserving meat for some time from taint.—The wood calamint, *C. sylvatica*, is a scarce and quite recently discovered British species, and forms a very beautiful floricultural object. Its flowers have a pale rose-colour, spotted with purple or blood-red, and are produced in whorls along the stems. It loves shade with some degree of warmth and shelter, and ought to be planted in a damp part of the garden, with exposure to only a moderate degree of sunshine.—The Nepete species, *C. nepeta*—called by Linnæus *Melissa nepeta*—grows wild on the chalky hills of England, has a height of about 20 inches, and carries blue flowers from July till October.—Two species, the Cretan and the shrubby, are small, half-tender, evergreen, under-shrubs, from the south of Europe, carrying purple flowers in June and July.—The great-flowered species, *C. grandiflora*, is an herb of a foot high from Italy, producing red-flowers from June till September; and it has a variegated-leaved variety. Two other hardy, perennial-rooted, herbaceous species have been introduced to Britain.—The name calamint signifies "beautiful mint," and is often loosely applied to handsome plants of several genera of the mint and thyme division of the labiate-flowered tribe.

CALAMUS. A genus of deciduous, tropical trees, of the palm tribe. The dragon species, *Calamus draco*, usually grows to the height of about 50 feet, and has an ornamental appearance. It

yields a considerable portion of the well-known dragon's blood of commerce; and it was introduced from India, in 1819, for ornamental culture in British hothouses. A sort of tincture of dragon's blood, or solution of it in arrack, is recommended by the Tamul physicians as an external application in cases of syncope and excessive languor; and the seeds of the plant are eaten by the Amboynese, in the hope of rendering themselves hardy in constitution, and invulnerable in war.—See the article DRAGON'S BLOOD.—The true species, *Calamus verus*, is sometimes called the small common rattan, and usually grows to the height of about 20 feet. It is used by the inhabitants of its native country for wickering chairs, couches, and beds, and for making mats, cages, baskets, and strong cables; and it is occasionally burnt by the painters, to furnish a black pigment. It was introduced to Britain, about twenty years ago, from Cochin-China.—The cable species, *Calamus rudentum*, sometimes called the *Great rattan*, is much thicker than the preceding species, and grows to an enormous length. It abounds in the woods of the southern parts of India; and, in consequence of its great strength and toughness, is often used in a green state for binding wild elephants, dragging sawmy coaches, and serving other purposes of a very powerful rope. It was introduced to Britain from India in 1812.—The white and the *zalacca* species, the former about 50 feet high, the latter about 20 feet high, and both of an interesting character, were introduced from India in the same year as the great rattan.—Seven or eight other species are known to botanists; and the fruit of one of these, *C. viminalis*, is eaten by the common people of India.

CALAMUS AROMATICUS. See ACORUS.

CALANDRA. A genus of coleopterous insects, of the curculio tribe. They possess more bad interest to the English farmer than any other genus of weevils. Their antennæ are inserted behind the middle of the rostrum, and are eight-jointed and geniculated; the terminal joint of the antennæ is a large knob, and the six succeeding joints are short; the rostrum is long, and slightly bent; the thorax is narrower before than behind, and somewhat long and depressed; and the abdomen is pointed at the apex, and depressed in the body, and longer than the elytra.

The palm species, *Calandra palmarum*, is an inhabitant of South America, and lives, during its larva state, upon the pith of palms. Its prevailing colour is dull velvet black; the upper part of its proboscis is provided with a tuft of black hairs; and its whole length is of the enormous extent of about an inch and a half. The natives of South America eat its larva as a great delicacy.—The rice species, *Calandra oryzae*, is distinguishable from our common corn weevil principally in having four red spots upon its elytra; and it feeds upon the rice grain in the countries of the East in the same manner in

which the corn-weevil feeds upon wheat in the granaries of England.

The grain-weevil species, *Calandra granaria*, is the only one which can be properly regarded as a native of Britain, and is so notorious for its devastations upon the stored produce of our corn-fields as to concentrate in itself nearly the whole interest of the genus. Its antennæ are scarcely longer than the head and the rostrum; the terminal joint of its antennæ is a somewhat ovate club, and the radical joint so elongated as, when bent backwards, to reach to the thorax; its rostrum is rather long; its thorax is elongate in body, and a little narrowed in front, and is covered with large oblong punctures; its elytra do not quite cover the abdomen, and are marked with deep lines, faintly punctured in the bottom; its legs are rusty red and rather short; its entire length is nearly two lines; and its prevailing colour is pale when it emerges from the pupa state, and brown or pitchy when it attains maturity. The larva is a small whitish worm, about a line in length, comprising nine segments, the body soft, the head harder, and the only external organs a pair of strong jaws. The pupa is white and somewhat transparent, and lies within the envelope of a grain of wheat nearly like the kernel of a nut within the shell. The rapidity of the transmutations, or the duration of the several states preceding the perfect one, is greatly influenced by temperature, and therefore varies in different countries, and in any one country in different seasons. But on the average, about forty or forty-five days transpire between the period of fecundation and the evolution of the perfect beetle; and the larger proportion of this time is consumed in the larva state. The insect is fearfully abundant in the south of France; it is also disastrously plentiful in all the southern counties of England; but it gradually decreases in number toward the centre and the north of England; and it becomes so comparatively scarce as not to perpetrate any very serious mischief in Scotland. The fecundity of the female is so vast that, in a single season, upwards of 23,000 individuals may descend from one mother; so that when the breeders are numerous, the progeny may amount to such countless millions of millions as almost to possess the power of an Egyptian plague.

The grain-weevil inhabits granaries and other places in which corn is stored. The female, with her rostrum, perforates the skin of one grain, deposits an egg in the perforation, and closes the aperture with a glutinous matter; and she proceeds thus with grain after grain till the whole of her eggs are deposited, never placing two or more eggs in one grain, but using as many grains as she has eggs. The larva is usually hatched in the course of a few days; and, by means of its pair of jaws, it feeds upon the farina of the grain, and continues to scoop it out and eat it till the whole is consumed. The pupa is now evolved by transformation of the larva, and lies enveloped

within the skin of the grain; and when the perfect insect is matured, it gnaws a passage for itself through the skin. The perfect insect also feeds upon the grain, attacking grains which have not been used by larvæ, and eating portions of their substance; yet it does not appear to consume much of their farina, but seems to inflict damage principally by its numerous piercings and fractures of their envelope. Grain which has been destroyed by the weevil presents no external indication of being unsound; yet is easily detected by its great comparative lightness; for when a sample containing some of it is thrown into water, all the unsound grains float on the surface.

Proposed and attempted remedies against the corn-weevil are numerous; but some are elaborate or difficult, and most involve nearly or altogether as much loss or outlay as the very evil which they are designed to remedy. The passing of the grain through a winnowing-machine, as nearly as possible at the time when the great proportion of the insects are transforming from larvæ to pupæ, is cheaper and easier than any other proposed method; and, if it were found to throw away all the damaged grains in the manner of chaff or light corn, it might, in the course of a season or two, completely expel the insect from a set of premises. The exposing of the corn to heat can rarely kill the eggs or larvæ without raising the temperature so high as to overdry and even calcine the corn. The exposing of the corn to such a degree of cold as would prevent the insects from propagating or from passing through their transformation, might be successful if a sufficient degree of cold could be steadily obtained; but, as free ventilation is the chief means which can be employed, no such degree of cold is attainable in summer,—the very season when the experiment would require it. The mixing of the corn with quicklime, sulphur, or any other substance which might be likely to nauseate or kill the insects, can scarcely be attempted without communicating a mischievous or deteriorating taint to the corn. "Of the various schemes that have been proposed," says Mr. Duncan, "the following is the most approved. When the individuals that have passed the winter in a torpid state, are beginning to recover their activity, and to move about among the corn, a small heap, composed of that kind of corn to which they are most partial (which is said to be barley), should be placed at a small distance from the principal store. The latter should then be turned over, and tossed about as much as possible, at intervals, that the weevils may be fairly disturbed and put in motion. Naturally very fond of quiet, and anxious to escape from such unceremonious treatment, they take refuge in the undisturbed heap placed as a decoy. When collected there in numbers, they are speedily incapacitated for further mischief by having boiling water poured over them in such quantities as completely to saturate

the heap. Such individuals as escape to the walls or elsewhere, may be swept together by a broom, and easily disposed of. The corn of the decoy-heap may afterwards be separated from the dead insects by sifting. Even though this plan may appear not to promise much in the recital, it is affirmed that, in practice, it has been attended with highly favourable results."

CALANDRINIA. A genus of ornamental plants, of the purslane family. The showy species, *C. speciosa*, is a splendid, hardy, trailing annual, of 3 or 4 inches in height, and carrying dark purple flowers from May till October. It was introduced about 15 years ago from New California.—The large-flowered species, *C. grandiflora*, is a beautiful, evergreen, herbaceous, hothouse plant, about a foot in height, and carrying purple flowers in June and July. It was introduced about twenty years ago from Chili.—The two-coloured species, *C. discolor*, is a splendid, evergreen, greenhouse, undershrub, about 20 inches in height, and carrying bright rose-coloured flowers in July and August. Its two-coloured property belongs to the leaves. It is a plant of very conspicuous beauty; and, being hardy during summer, is capable of contributing its brilliance to the open flower-garden. It resembles the large-flowered species; but its flowers are four times as large, and have the valuable property of remaining fully expanded under a cloud, or even during the dull-est weather.—Fourteen or fifteen other species have been described by botanists; and seven or eight of these have recently been introduced to the gardens of Britain.

CALANTHE. A genus of evergreen, herbaceous, tropical, ornamental plants, of the orchis tribe. The name means "beautiful flower," and justly indicates the genus to be an accession to the superb and bewildering attractions of the orchideous houses of our gardens. The veratrum-flowered species, *C. veratriflora*, grows to the height of about two feet, and carries a white flower in June and July. This species was introduced in 1819 from the East Indies; and since that time, six other species have been introduced from Java, Sylhet, New South Wales, and Madagascar.

CALATHEA. A genus of evergreen, herbaceous, tropical, ornamental plants, of the Indian-shot tribe. They belong to the first and small Linnæan order, which have only one stamen; and they take the name of Calathea, which signifies 'a basket,' from the curious and unique shape of their stigma. The species popularly called the Zebra plant, *Calathea zebrina*—but designated by some botanists *Maranta zebrina*—grows to the height of about two feet, and carries a reddish-yellow flower throughout the greater part of the year, and was brought to Britain, about thirty years ago, from Brazil. Eight or nine other species are known; and most of them have been brought to Britain since the introduction of the Zebra plant.

CALCAREOUS EARTH. Either carbonate of lime in nearly a pure state, or an earthy mixture of which it is one of the ingredients. Calcium is a simple or elementary body, of a metallic nature, nowhere naturally existing in a separate condition, and artificially obtainable only in small quantities and by a difficult process. Lime or quicklime is an oxide of calcium, and is usually obtained by expelling carbonic acid from rocky or earthy bodies containing carbonate of lime in large proportion. Carbonate of lime is the chief ingredient in chalks, limestones, and several kinds of marls and spars, and exists in nearly a pure state in such limestones as constitute the finest sorts of statuary marble; and this substance, whether as constituting lithological strata in portions of the globe's crust, or as crushed to powder and intermixed with other substances in the forms of diluvium and alluvium, is what mineralogists and scientific agriculturists designate calcareous earth.

Some soils naturally contain such large proportions of calcareous matter as to be themselves properly and characteristically designated calcareous; some contain it in sufficient proportion for the purposes of fertility, either by natural intermixture of limestone debris, chalk, shells, or marl, or by artificial commixations and manurings of quicklime; and others are nearly or wholly destitute of it, and consist principally or wholly of argillaceous, siliceous, or hypnotic matter. The adding of calcareous earth, in the form of either top-dressing or incorporated manure, to the first of these classes of soils, would, in most cases, be sheer poisoning; the adding of it to the second class must, in all cases, be regulated by the niceties of judicious husbandry; and the adding of it to the third is, in almost every case, essential to the extraction from them of remunerating or even meagre crops.

All the calcareous earths, when burnt or calcined, become friable, and fall into a white powder; they evolve strong heat, and fall more or less readily into powder, if, after being calcined, they are drenched with water; they cannot by themselves be vitrified in a close fire; they augment, in their burnt state, the causticity of potash; and they exhibit powerful alkalinity by free and copious effervescence in acids.—Calcareous earth exists nearly pure, in the form of a powder, in moors, at the bottom of lakes, and in the fissures of sandstone quarries, in Oxfordshire, Northamptonshire, and some parts of Sweden. This powder is sometimes called *lac lunæ*; it is supposed to be the debris of limestone rock, pulverized by the motion of water; it has a white colour in England, and a colour varying to yellow and red in Sweden; but it occurs in too small quantities to admit of application to the uses of agriculture.—Calcareous earth occurs both friable and compact in the form of chalk; yet, when in this form, it always contains some admixture of other earths, and a very large propor-

tion of carbonic acid. White chalk is the least impure of the chalks; and yet it contains some silica, and about two per cent. of argillaceous earth.—Calcareous earth occurs in a gravelly form in limestone gravel, and in a compact and indurated form in limestone rock. Yet, in this form, it always contains some proportion, and sometimes a very large proportion of siliceous and argillaceous earths. Some limestones, also, as the dolomites, have magnesium and not calcium for their ultimate base, and may prove very unsuitable or even poisonous succedanea for calcareous manure.—An earth of calcium, though not properly a calcareous earth, occurs in the form of gypsum or plaster of Paris. This substance is a combination of lime and sulphuric acid, while marble, chalk, or any other true calcareous earth, is a combination of lime and carbonic acid; and it does not effervesce with acids, and, when calcined to powder, concretes and hardens under the subsequent action of water; yet though so different, in at once chemical constitution, alkalinity, and mechanical property from a true calcareous earth, it readily contributes its base of lime as a manure, and merits full consideration in the treatment of soils which require to be dosed with calcareous matter.—Calcareous and argillaceous earths occur combinedly in the form of marls; but they exist in such widely different proportions as to have occasioned a loose general classification of marls into shell marls and clay marls. All true marls effervesce with acids,—and the strongly calcareous proportionably more than the weakly calcareous; yet some pure clays, when in a dry state, evolve a quantity of air under the mere action of water, as well as under the action of a liquid acid, and have in consequence been mistaken for marls. Highly calcareous marl consists principally of the shells of aquatic animals, and is often so entirely free from clayey matter as to be very strictly a calcareous earth. See the articles LIME, CHALK, GYPSUM, MARL, and SOILS.

CALCEOLARIA. A genus of herbaceous and shrubby ornamental plants, of the figwort tribe. It first became known in Britain so late as the year 1773; it did not become known, in any of its finer or more beautiful species, till the year 1822; it did not evoke for itself, from either amateur or professional florists, a fixed or normal law of beauty, till about 1828; it did not produce any decidedly good English hybrids till about 1830; and yet it already fills whole greenhouses in the public nurseries,—it boasts an almost innumerable multitude of brilliant and most fascinating hybrids,—it figures most conspicuously in even the smallest collections of tolerably good flowering plants,—and it possesses so enthusiastic favour and such a lofty fashionableness, that one-half of all the unscientific flower-fanciers of our country appear, for the present, to have gone calceolaria-mad. We have

no hope, therefore, of being able to afford such prominence to this genus as would be in keeping with its prodigious and bulky ascendancy in the public nurseries or in public favour.

All the species of calceolaria yet known are natives of the countries on the west side of the Cordilleras, or of the southern islands and southern continental districts of South America. The most beautiful are natives of Chili and Peru, and grow so abundantly in these countries as to impart their hue to the general vegetation, nearly in the same manner in which daisies, dandelions, buttercups, and primroses gem the several kinds of sward and pasture in England. Some inhabit the low-lying districts of their native regions; and others inhabit the lofty portions of the Andes which are situated immediately below the rocky, pinnacled, barren and almost bare region of the alpine lichens. The species of Chili are different from those of Peru and Patagonia; and the species which inhabit the plains are much more tender than the species which inhabit the mountains; yet almost all the fine English hybrids, whether retaining the original habit of the Chilian species, or somewhat acclimated by the process of hybridizing, possess the medium tenderness of greenhouse plants.

The flower of a calceolaria has two stamens and a two-lipped monopetalous corolla; and the lower lip is so much larger than the upper, and so completely inflated or heaved out as to cause the whole corolla to have the shape of a purse or bag. The ground colour of most is yellow, and that of others is white, sulphur-colour, straw-colour, ochreous-colour, orange, brown, or intermediate shades; and many, especially of the hybrid kinds, are profusely variegated with dots, stripes, and blotches of a second colour. The normal character of a prime plant, as propounded by Mr. Glenny in his "Properties of Flowers," and concurred in by most cultivators, but generally applicable to only the finest hybrids, are as follows: "The plant should be shrubby; the foliage thick and dark green; the wood strong. The flower-stems should be short and strong; the footstalks of the blooms elastic, and branch well away from each other, to form a rich mass of flowers without crowding. The individual blooms depend entirely on the form of the purse; and it should be a perfect round hollow ball. The orifice and calyx cannot be too small, nor the flower too large. The colour should be very dense; and whether it be a spot in the middle, or stripes or blotches, should be bold and well defined; and the ground should be all one colour or shade, whether white, straw-colour, sulphur, yellow, or any other. The colour of itself should be brilliant, and all over the same actual shade. Dark flowers with pale edges, or clouded or indefinite colours, are bad and unfit to show. The bloom should form one handsome bunch of pendant flowers, commencing where the foliage leaves off; and the flower-stems should

not be seen between the foliage and the flowers, which should hang gracefully, and be close to each other; the branches of the flower-stems holding them out to form a handsome spreading surface."

The pinnate-leaved species, *C. pinnata*, was introduced from Peru in 1773: it is a half-tender annual, grows about two feet high, and carries yellow flowers from July till September.—Fothergill's species, *C. Fothergillii*, was introduced from Falkland's Island in 1777: it is a small evergreen herb of about 6 or 8 inches in height, and carries orange-coloured flowers from May till August.—The scabious-leaved species, *C. scabiosifolia*, was introduced from Chili in 1822; and is a trailing evergreen of about two feet in height, and carries yellow flowers from May till October.—The wrinkled and the entire-leaved species, *C. rugosa* and *C. integrifolia*, were also brought from Chili in 1822; and they are evergreen undershrubs of about two feet in height, and carry yellow flowers in August and September.—Herbert's species, *C. Herbertiana*, was introduced from Chili in 1828; and is an evergreen herb of about two feet in height, carrying yellow flowers from May till October.—The two-coloured species, *C. bicolor*, called by some botanists *C. diffusa*, was brought from Peru in 1829; and is a shrub of two feet in height, with yellow and whitish flowers.—The narrow-flowered species, *C. angustiflora*, was brought from Peru in 1830; and is a shrub of about 20 inches in height, with yellow flowers.—The Chiloe species, *C. chilensis*, was brought from Chiloe in 1830; and is a shrub of two feet in height, with yellow flowers.—The very clammy species, *C. viscosissima*, was brought from Chili in 1832; and is a shrub of three feet in height, with orange yellow flowers.—The purple species, *C. purpurea*, was brought from Chili in 1831; and is a hardy herbaceous plant, of about a foot in height, with pale purple flowers.—The sessile species, *C. sessilis*, was brought from Valparaiso in 1832; and is a shrub of about 20 inches in height, with yellow flowers.—The white species, *C. arachnoidea*, was brought from Chili in 1832; and is an herb of about a foot in height, with white flowers.

To enumerate all the English hybrids, or even a tolerably fair specimen of them, is the business of a professional florist's catalogue. We can afford to mention only a few of the finest which were first produced; and we take, as our authority for these, as we have also done for our notice of the several species, the last edition of Loudon's *Hortus Britannicus*:—*C. Gellianiana*, intermediate between *corymbosa* and *purpurea*, with an ochreous and dark flower; *C. Hopeana*, intermediate between *corymbosa* and *plantaginea*, with yellow flowers; *C. Morrisoni*, intermediate between *Fothergillii* and *integrifolia*, with ochreous flowers; *C. Polyantha*, intermediate between *corymbosa* and *petiolaris*, with yellow flowers; *C. Youngii*, *C. Y. pallidior*, *C. Y. dilecta*, *C. Y. atra*, intermedi

ate between corymbosa and arachnoidea, with respectively ochreous and dark, pale, bright brown, and dark flowers; and *C. mirabilis*, intermediate between pendula and insignis, with purple flowers.

Persons who intend to grow calceolarias should purchase, at a nursery, a few sorts with flowers as nearly as possible to the globular form, no matter of what size, but with about three different ground-colours, and three different blotch-colours; and if they carefully rear these for one season, they will obtain abundance of seed, and, by means of these, a profusion of beautifully flowering plants. The herbaceous kinds at first yielded larger flowers than the shrubby kinds, and, on that account, acquired a temporary popularity; but they are by no means so handsome as the shrubby sorts, and ought never to be selected when the latter can be obtained.

The seed-pods should be gathered when turning yellow, and should be laid to dry on a sheet of paper under a hand-glass. The seed may be sown, in early spring, on soil in seed-pans or in flower-pots well drained with crocks, and placed either under the glass of a garden-frame, or under a hand-glass in the greenhouse. When the young plants become large enough to be handled, they may be picked out, and reset an inch apart in other seed-pans; and may be allowed to grow there till they begin to incommode one another for space. They may then be potted in sixty-sized pots, and placed to grow, in a medium state between draught and humidity, in either a pit or a frame. If the green aphid attack them, it must be destroyed by means of a gentle fumigation with tobacco-smoke. When the plants send their roots a little matted to the sides of the pots, they may be removed into forty-eight sized pots; and should they afterwards acquire considerable strength and bulk before flowering, they may be further removed into thirty-two sized pots. They will flower in spring; and all the bad and indifferent ones must be either thrown away as rubbish, or planted at a distance in the borders. The good or selected plants may be headed down in the pots, earthed up, and set to produce side shoots. If the earthing up be sufficiently high and porous, many rooted side shoots will speedily appear; and may be easily detached from the parent plants, and set to grow in separate pots. Other side shoots which spring out from higher parts of the stem must be detached as closely to the stem as possible, so as to be planted in pots without losing their bottom joint; and they should be covered with a bell-glass pressed into the ground to exclude the air, there to remain under shade and shelter till they strike root.

CALCINATION. An action of heat upon a mineral similar to that which converts limestone into quicklime. The old chemical name of quicklime was calx; and this name was extended to any powdery metallic oxide which has an earthy aspect; and the process of forming a calx was

called calcination. This process, therefore, was very various in chemical character; for in the case of lime, it consisted in the expulsion of carbonic acid; and in the case of the oxidation of metals, it consisted in fixing oxygen. The word, as at present used, is simply a convenient popular designation of all such applications of heat as reduce a compact body into a white powdery condition. Thus, we speak of calcined magnesia, calcined clay, calcined flints, and even calcined bones. But the calcined metals which were formerly called calxes are now uniformly designated oxides.

CALCIUM. A simple or elementary body, of a metallic nature. It was first obtained in a separate state in 1808, by Sir H. Davy, by means of the action of voltaic electricity. It has so powerful an affinity for oxygen as nowhere to exist uncombined with it in nature, and as to be separable from it, or kept separate, only with extreme difficulty. It has been ascertained to be a white combustible metal, burning in contact with the air, with an intense white light, into lime. Combinations of calcium with various other elementary bodies occur; but, excepting the combination with oxygen constituting lime, they are wholly artificial. The practical value of calcium, therefore, whether in its natural occurrences or in its artificial combinations, is wholly identified with lime. See the articles **LIME** and **CALCAREOUS EARTH**.

CALCULUS. Any kind of concretion formed in any part of the body of an animal, and possessing some resemblance, in shape or composition, to a stone. Calculi are considerably varied in their manner of formation, much varied in their seat and effects, and exceedingly varied in their composition. Some appear to be formed by the action of chemical affinity, and possess the character of regular crystals; and a few of these may originate in the mere chemical aggregation of minute particles of their elements held in solution in the animal fluids, while most seem to originate in the attachment of their first particles to a fragment of some foreign body, such as a minute clot of blood or mucus, a minute piece of hair, or a minute speck of insoluble mineral matter. Many are formed by the mere mechanical amassment and consolidation of heterogeneous, undissolved, mineral particles, around a nucleus, or by the mechanical segregation of such particles, by means of animal gluten; and some are formed by regular though diseased secretion, the absorbent vessels drawing off all the liquid elements of the matter which would have constituted a healthy secretion, and leaving the other elements in a sedimentary condition to harden into strong consistency.

Salivary calculi, formed by concretion of matters held in solution by saliva, frequently occur upon the teeth, beneath the tongue, and in the salivary ducts in the substance of the cheek. The substance, technically called tartar, which

accumulates upon the ill-kept teeth of man, and which is very hard and adhesive, and has a gritty structure and a dirty yellow colour, is a salivary calculus, and consists of phosphate and carbonate of lime. Calculi within the salivary glands sometimes acquire so great a size, that they require to be extracted with the knife; but, in consequence of the greater expenditure of saliva, and the keener irritability of the salivary glands, they are much more frequent in herbivorous animals than in man. They have generally an oblong shape, a dense structure, a smooth surface, and a dead-white colour; they occur most frequently in the parotid gland; and when they become so large as to obstruct the flow of the saliva, and cause the perceptible distension of the duct, they must immediately be removed by incision, else they will cause the duct to burst. A salivary calculus extracted from the gland of an ass was found by M. Caventon to contain 91.6 per cent. of carbonate of lime, 4.8 of phosphate of lime, and 3.6 of animal matter; and a salivary calculus extracted from the mouth of a horse was found by M. Henry to contain 85.52 per cent. of carbonate of lime, 7.56 of carbonate of magnesia, 7.56 of phosphate of lime, and 2.48 of animal matter.

Subcuticular calculi are formed beneath the skin, chiefly around the joints of the fingers and toes of man. They have an appearance somewhat similar to that of half-dried mortar; they are popularly called chalk-stones; and they have been found to consist principally of urate of soda. They are formed around the joints of gouty and rheumatic persons; and, in some cases of prolonged and severe rheumatism of the head, they have been found between the skin and the cartilage of the ear. They sometimes cause ulceration; and when they protrude through the skin, they can easily be removed.

Gastric calculi occur chiefly in the rumen and the abomasum of ruminating animals. Some curious calculi of this class are noticed in our article on BEZOARS. Calculi in the stomachs of cattle vary in weight from a few ounces to six or seven pounds, and are exceedingly diversified in composition, and have generally, though not always, a somewhat spherical shape. "Those which are decidedly peculiar to cattle," says Mr. Youatt, "are composed entirely of hair matted together by the mucous secretion from the follicular glands of the stomach. Sometimes they have no distinct central body; at other times it exists in the form of a bit of straw or wood, or frequently of stone or iron. They exist in the rumen and in the abomasum. In the abomasum, they are composed exclusively of hair, irregularly matted and held together by the mucus of the stomach; in the rumen, there is generally a mixture of food or earthy matter in the composition of the concretion. When simple food mingles with the hair, the ball seems to be formed by a succession of concentric layers, and in the centre is a bit of nail or stone; or, if the beasts have

access to running water, a piece of shell often constitutes the nucleus." The hair is obtained by the practice which cattle have of licking one another; and it sometimes occasions the formation of large calculi in very young cattle. Calculi which contain but little hair are usually an agglutinated mass of earthy matter and the materials of food, round a small piece of metal or some other hard central nucleus; and, though formed by concentric layers, they exhibit these in irregular thicknesses and confused succession. Many of the hard and spherical calculi of the rumen, when sawn asunder, display the concentric layers in a perfectly regular and beautifully marked condition, and are susceptible of a high degree of polish. Calculi are found chiefly in unthriving, lean, and sickly cattle; but whether they are the cause or the effect of want of healthy tone in the stomach, is not known.

Intestinal calculi, in man, are usually roundish agglutinations of fibrous and calcareous matter upon such nuclei as minute pieces of bone and small drupes of fruit. Most are smooth, compact, and comparatively light; and some possess alternate layers of such earthy matter as phosphate of lime, and such vegetable matter as the skin or chaffy integument of oatmeal. They frequently occasion pains resembling colics; they encounter much less resistance to a passage toward the rectum than in quadrupeds; and, in most instances, they cannot be certainly known or even tolerably conjectured to exist till they effect their escape, and cease to give any trouble. Intestinal calculi, in horses, produce vastly more serious effects than in man, occasioning obstructions, inflammations, violent colics, ruptures of parts of the intestines, and not infrequently death itself. The earthy and heaviest kinds of them vary in weight from a few grains to several pounds, and lie ensconced in the cells of the colon or the deep pouch of the cæcum, and assume a diversity of shape according to the form of the nucleus on which they gather, or of the particular cell in which they lie; and, in consequence both of the cavitous character of their retreat, and of the horizontal position of the whole of the animal's abdomen, they can make little or no way toward the rectum, but are necessarily retained in their places till they become so large and heavy as to cause irritation and oppression at every movement of the animal, and eventually to produce fatal inflammation, or to rupture the cells or membranes in their vicinity. They occur most frequently in millers' horses and various classes of heavy draught horses, and are supposed to be, in many instances, induced by combinations of bran with pulverized earths and stones. Other kinds of intestinal calculi, which often occur in the horses of millers and brewers, have irregular shapes and tuberculated surfaces, and consist principally of the filamentous portion of the grain of oats, and are supposed to be occasioned by the use of poor, thin, husky oats, and are sometimes

known by the popular designation of oat-hair calculi. Other kinds, usually found in voraciously feeding horses, are coarse agglutinations of the same matters which compose the preceding, and of pieces of stone, coal, and gravel, and of many sorts of coarse and indigestible ingredients, and are sometimes popularly known under the vile yet not altogether inappropriate designation of dung-balls. No medicinal appliance for expelling or reducing the intestinal calculi of horses has yet been discovered; so that prevention, and not cure, must be studied.

Biliary calculi occur in the gall-bladder of man and of some of the inferior animals. They exist sometimes solitarily, sometimes in groups of from three to six, and occasionally in almost incredible numbers. So long as they continue in the gall-bladder, they occasion little inconvenience; but when they pass from that organ into the duct of communication with the duodenum, they generally occasion much pain and squalor, and sometimes almost totally obstruct the flow of the bile, and originate the disease which is popularly known under the name of jaundice. If they continue to obstruct the duct, death must eventually be the result; but when they pass into the duodenum, either spontaneously, or under the influence of such medicinal appliances as aperients, emetics, anodynes, and fomentations, they cease to cause injury, and allow the health to be immediately restored. The biliary calculi of man were supposed by Fourcroy and Thenard, to consist principally of a peculiar fatty matter which resembles spermaceti, and has been called adipocire; but have been found by Chevreul, Turner, and other chemists, to consist, in general, of the yellow colouring matter of the bile and cholesterine, the latter predominating, and being sometimes in an uncombined or pure condition. Yet some contain a large proportion of mere inspissated bile; and a few, though but a few, are wholly destitute of cholesterine. The biliary calculi of oxen consist almost entirely of that yellow colouring matter of the bile, which, from the beauty and permanence of its tint, is in high request among painters. "This substance," remarks Turner, "is readily distinguished by its yellow or brown colour, by insolubility in water and alcohol, and by being readily dissolved by a solution of potash. The solution has at first a yellowish-brown colour, which gradually acquires a green tint, and is precipitated in green flocks by muriatic acid. According to the observations of Tiedemann and Gmelin, the colouring matter is influenced by the presence of oxygen gas. The yellowish precipitate, occasioned by adding muriatic acid to bile, absorbs oxygen by exposure to the air, and its colour changes to green. The action of nitric acid is still more remarkable. By successive additions of this acid, the tint of the colouring matter may be converted into green, blue, violet, and red, in the course of a few seconds."

Urinary calculi occur in the kidneys, the ureters, the bladder, and the urethra of man and of almost all the domesticated animals. The urine of a healthy man is a combination of no fewer than twelve or thirteen different proximate elements; the urine of man, under the action of several kinds of disease, includes some additional and very distinctive elements; and the urine of the greater number of the domesticated animals is, on the whole, as remarkable as that of man for complexity. Some of the proximate elements, as soda and ammonia, are alkalies; some, as lime and magnesia, are metallic oxides; and some, as hippuric acid in the horse, and uric, phosphoric, and oxalic acids in man and other animals, possess the power of chemically attacking and neutralizing both the alkalies and the metallic oxides. In various conditions of the urinary organs, or of the absorbent and vascular systems, several of the combining elements rush into mutual union, and form solid precipitates and crystalline deposits, which possess the character of calculi, and occasion the irritations, inflammations, and other symptoms of the well-known diseases called gravel and stone.

A frequent kind of urinary calculus consists of uric acid. A calculus of this kind is hard, smooth, inodorous, of a brownish or fawn colour, commonly of an oval form, and composed of concentric layers, which are formed round a central nucleus, and are distinguishable from one another by slight differences of colour, and sometimes by laminæ or dustings of some foreign substance. A calculus of urate of ammonia is very closely similar to the calculus of uric acid, being distinguishable by some peculiarities of behaviour under the test of chemical reagents; but it is of exceedingly rare occurrence. An urinary calculus of bone earth or phosphate of lime has a pale brown colour, and a remarkably smooth polish; and, if cut through the middle, is seen to be composed of concentric layers, very regularly formed, and so slightly adherent to one another as to admit of very easy separation. Some bone-earth calculi exhibit ammoniaco-magnesian phosphate in minute sparkling crystals, either on their surface or between their laminæ; and a few calculi, comprising bone-earth, possess a preponderance of the ammoniaco-magnesian phosphate over the phosphate of lime, and these are generally whiter and less compact than the ordinary bone-earth calculi. A particular kind of urinary calculus technically known as "the fusible," consists of a mixture of the phosphate of lime and the ammoniaco-magnesian phosphate; it has usually a white colour, and a rugged or otherwise uneven fracture; it easily breaks, pulverizes, or separates into layers, and, when crushed or taken asunder with the hand, leaves a white dust upon the fingers; and it is of comparatively frequent occurrence, and often attains a comparatively large size. An urinary calculus of oxalate of lime is shaped somewhat like the fruit of the mulberry, and,

for this reason, is technically known as the mulberry calculus; and it is very hard, compact, dark-coloured, and tuberculated. A rare kind of calculus was called by Dr. Wollaston cystic oxide, on account of its behaving like an oxide and seeming to be peculiar to the bladder; but it differs in constitution from the ammoniaco-magnesian phosphate principally in being more compact, and has been found in the kidney; and it does not possess concentric layers, but appears a confusedly crystallized and somewhat uniform mass. A compound urinary calculus consists of an intimate mixture of the ingredients of different kinds of calculi; and an alternating calculus consists of alternate layers of the ingredients of two or more kinds; but neither of these has ever been known to comprise any cystic oxide. A calculus of a yellow or reddish-yellow colour has been called xanthic oxide on account of its yellowness and its oxidal behaviour; another possesses properties closely similar to fibrin, and has been called the fibrinous calculus; and another consists principally of carbonate of lime; but all these three are of exceedingly rare occurrence. Siliceous matter appears occasionally to be found in some urinary calculi, but seldom or never in such quantity or with such effect as to produce any characteristic property or appearance.

The urinary calculi of the lower animals, though quite similar to those of man in their nosological connexions, considerably differ in their chemical composition. Uric acid, in an uncombined state, does not seem to occur in any; and, even in a combined state, occurs in very few. The ammoniaco-magnesian phosphate occurs principally in the hog, and, with the addition of animal gluten, constitutes nearly all the urinary calculi of that animal. Carbonate of lime constitutes about 91 per cent. of the urinary calculi of the ass, 87 per cent. of those of the ox, and 83 per cent. of those of the horse; and the other ingredients are principally phosphate of lime and animal gluten. A calculus which was extracted, a few years ago, from the bladder of a mare in Aberdeenshire was found to be eight ounces in weight, and to consist of about 40 per cent. of carbonate of lime, and about 60 per cent. of animal matter, apparently mucus of the bladder and indurated albumen. A calculus taken, not long ago, from the urethra of a pig at Boonjedward in Roxburghshire, exhibited considerable resemblance to many of the calculi which are extracted from man. "The external surface, presenting a beautiful, white, crystallized appearance, was composed of a triple salt,—the phosphate of magnesia and lime; the interior, a dark brown portion, also in a crystallized state, was composed of uric acid in combination with these phosphates." Siliceous sandy particles occasionally lodge and even accumulate in the bottom of the bladder of every kind of domestic animal. Numerous small calculi frequently occur in many of them, and occasion retention of urine and apparently severe pain.

Calculi of comparatively great size and weight, exciting disease and even inducing death, sometimes occur in various domestic animals, particularly in the dog, the ox, and the horse.

Minute calculi sometimes pass spontaneously away with the urine, or, if reluctant to pass with it, may be incited forward by the force of diuretic medicines. But calculi which are not quite minute, and especially calculi of any considerable size, can be prevented from accumulating till they prove fatal, only by being extracted entire, or by being so broken and triturated that they can pass with the urine. The surgical operations for effecting their extraction or reduction are, in most instances, performed very successfully on man, and have often, especially of late years, been performed successfully on domestic animals; and they will be described in our articles LITHOTOMY and LITHOTRITY.

Speculations many and sanguine have been entertained as to the possibility of dissolving calculi, so as to dispense with lithotomy or lithotritry, and to make the materials of the calculi pass off with the urine. "From the solubility of urinary concretions in chemical menstrua," says Dr. Turner, "hopes were once entertained that reagents might be introduced into the urine through the medium of the blood, or be at once injected into the bladder, so as to dissolve urinary calculi, and thus supersede the necessity of a painful and dangerous operation. It has been found, however, that, for this purpose, it would be necessary to employ acid or alkaline solutions of greater strength than may safely be introduced into the bladder; and consequently all attempts of the kind have been abandoned. The last suggestion of this nature was made by Messrs. Prevost and Dumas, who proposed to disunite the elements of calculi by means of galvanism. This agent, however, though it may produce this effect out of the body, will scarcely, I conceive, be found admissible in practice." Yet though the idea of dissolving the strongly indurated and densely crystalline calculi of man may be somewhat visionary, the proposal for dissolving or disintegrating the calcareous matters which form the chief bulk of most of the calculi of herbivorous animals, may be perfectly feasible, and of considerable practical value. "From the composition of the calculi in these animals," says Professor Dick, "they may be dissolved in the bladder, and discharged in a fluid state. This may be done by employing muriatic acid, which, having a strong affinity for lime, will, by the administration of a sufficient proportion of it, dissolve the calculi, and discharge them with the fluid. And this would, in some cases, be the more readily effected, as it sometimes happens that the calculi deposit remains in a semifluid state for a considerable time in the bladder, of which I once met with a remarkable instance. A bladder was sent to me, for examination, from Fife, which, with its appendages, contained the enormous

weight of about 14 lb. of a mass of nearly the consistence of lime in a state of mortar. Wherever, therefore, a case occurs in which circumstances may render an operation inexpedient, or where, for example, the calculus is situated in the pelvis of the kidneys, muriatic acid should at once be employed; and if the calculi in our herbivorous animals are always composed of mere carbonate of lime and animal matter, the operation may be entirely dispensed with. A weak solution of muriatic acid might even be injected into the bladder, either in the male or female, by which the substances would be dissolved with great rapidity." See the article **STONE IN THE BLADDER**.

Pulmonary calculi are sometimes formed in the lungs of persons who are labouring under pulmonary consumption. They are of various sizes from a minute concretion to a hard irregular mass of about the bulk of an almond; they usually consist of bone-earth; they sometimes adhere to the tissue of the lungs, but more frequently lie imbedded in the tubercular deposits; and, in some instances, they pass with the purulent discharge into the air-tubes, and are brought away by expectoration.—Various kinds of calculi, consisting principally of carbonate of lime, bone-earth, and animal cementing matter, occur in scrophulous, fungous, and cancerous growths on the exterior parts of the body,—in the interior of the muscles of the brain, and of other organs, where they partake in some degree of the character of ossifications,—and round small hard nuclei in any of the interior vessels, where these experience the play and the abrasions of the secretive juices.—Some small and peculiar calculi are formed also within the vascular system, and occasion rigidity of the arteries, and diseases of the heart.—Calculi of great hardness, a white colour, and various shapes, and usually consisting of pure bone-earth, are sometimes formed in the cerebrum or cerebellum of the horse, and occasion first irritation and increasing stupor, and afterwards sudden and fatal inflammation.

CALDASIA. See **BONPLANDIA**.

CALENDAR. A recorded distribution of the divisions of the year, upon scientific principles, and for practical uses. The *kalendæ* or *kalends* of the Romans comprised the first day of every month, and have bequeathed their name, in the modified form of calendar, to all systematic distributions of the months. A natural calendar is the indication of the seasons by the phenomena of meteorology, the economy of the lower animals, and especially the leafing, flowering, fruiting, and hybernating of the different kinds of plants; and an artificial calendar is either a register of the natural appearances and out-of-door work peculiar to the respective seasons and parts of seasons, or a distribution of the year into parts and subdivisions corresponding to the revolutions of the earth and the succession of the seasons. An almanac differs from a calendar in the last of

these senses, chiefly by adding to it a register of celestial phenomena, and of festivals and other remarkable days.

The several calendars used by the ancients have either been abolished or very greatly modified. The Greek or Attic calendar distributed the year into twelve lunar months, of alternately 29 and 30 days; and intercalated a lunar month, for the most part, every two years; yet occasionally omitted the intercalary month, so as to make the regular months recur at exactly the same natural seasons. This calendar also divided each of its months into three decades. The original Roman calendar assigned only 304 days to a year, distributed these into ten months of unequal length, and reckoned March as the first month of the ten; and the nomenclature of the last four months of this calendar is still retained in our own usages,—the names September, October, November, and December, signifying simply the seventh, the eighth, the ninth, and the tenth months. A subsequent Roman calendar, established by Numa, assigned 355 days to the year, distributed these into twelve months, and intercalated, between the 23d and the 24th of February, in every second year, a month of variable length. The Julian calendar, established by Julius Cæsar, and continuing, with slight change, to be used till the present day, assigned 365 days to the year, distributed these among the twelve months in the proportions still observed, and appointed a twenty-ninth or intercalary day to be added, in every fourth year, to the month of February. The Gregorian calendar, established by Pope Gregory XII. in 1582, adjusted the Julian calendar to more accurate astronomical observation of the actual length of the true year, by 'altering the style,' or throwing out ten days of the year in which it was established, between the 4th and the 15th of October, and by ordaining that, in all time to come, the intercalary or leap-year day of the first hundredth, the second hundredth, and the third hundredth year of every four hundred years, should not be reckoned; and this new calendar is, in consequence, simply the Julian one, with a deduction of three days in every four hundred years; or it constitutes what is popularly called the new style, while the Julian calendar constitutes what is popularly called the old style. The new calendar or new style was adopted in England, in the year 1752, by the elision of eleven days between the 2d and the 14th of September; and in the same year, an English statute changed the commencement of the legal year from the 25th of March till the 1st of January.

The Romans called the first day of the months *kalends*; the seventh day of March, May, July, and October, and the fifth day of the other months, *nones*; and the fifteenth day of March, May, July, and October, and the thirteenth day of the other months, *ides*; and they named any individual day, not in relation to the whole of

the month in which it occurred, but in relation to the particular kalends, nones, or ides, which it immediately preceded. The kalends, from *calando* or *vocando*, alluded to the calling or proclaiming of new moon by the high priest; the nones or *nonæ* were, inclusively, 'the ninths' before the ides; and the ides, from a word signifying 'to divide,' were 'dividers' of the month, cutting each into nearly equal parts.

The calendar used throughout Persia, is peculiar to that country, and dates from a peculiar era. The Mahommedan or Arabian calendar is used in every Mahommedan country except Persia, and dates from the era in Mahommed's life called the Hegira. The Jewish calendar, or that at present used by the Jews, is not of higher date than the second century, or very probably was not known till the fourth century, or even till a later period.—The calendar of the French republic was established in 1793, and abolished in 1805; and yet, though of such short continuance, it was so peculiar in itself, and has left such broad traces in history, that it will long figure as a subject of great curiosity. This calendar divided the year into twelve months of thirty days each, and a supplementary or festival period of five days, called the Sansculotides; it divided each month into three decades or ten-day weeks; it appointed leap-year intercalations in the same manner as the Gregorian calendar; it constituted each cycle of four years, ending with a leap-year or olympic year, a Franciade; and it gave to the respective months new and peculiar names, which were intended to be descriptive of the several characters of the months in the calendar of nature. Its month nivose, or the snowy, extended from the 21st of December till the 20th of January; pluviose, or the rainy, from the 20th of January till the 19th of February; ventose, or the windy, from the 19th of February till the 21st of March; and so on with the others.

January was the first of the two months added by Numa to the original Roman calendar; and, though not treated as the first month of our year till 1752, it was regarded, from the time of the establishment of the Numan calendar, as the first month of the Roman year. Janus, whom it commemorates, was one of the deities of the heathen Romans, represented with two faces, and is usually supposed to have been a very ancient king of Italy; but he was really the impersonation of Noah, looking backward, with an old and sorrowful countenance, to the antediluvian world, and forward with a young and joyous countenance, to the world after the flood. The heathen Saxons called January Wolfmonth, on account of its being the season when wolves were most dangerous; and the Christian Saxons called it Afteryule, on account of its succeeding the festival of Christmas.—February was the second of the two months added by Numa, and was named in honour of the heathen goddess Juno, who, under the designation of Februa,

Februara, or Februalis, was supposed to preside over the purification of women. The Saxons called it Solmonth; and the Flemings call it pruning-month.—March was the first month of the original Roman calendar; and was named in honour of Mars, whom the heathen Romans worshipped as the god of war, and as the supposed tutelar deity of the city of Rome. The heathen Saxons called it Rhedmonth, in honour of their goddess Rheda; and the Christian Saxons called it Lentmonth or the month of spring.—April was named by the Romans, from the verb *aperire* 'to open,' in allusion to the opening vegetation of spring; and was afterwards, for a brief period, called Neronus, in honour of the infamous tyrant Nero. The heathen Saxons called it Easter-month, in honour of their goddess Easter; and the Christian Saxons continued this name, but with altered allusion to the Christian passover.—May was named by the Romans, either in honour of Maia, the mother of Mercury, or in honour of the goddess Rhea, under her name of Maia. The Saxons called it the three-milk-month, in allusion to a supposed threefold abundance of milk, from the succulency and stimulation of the young and profuse herbage.—June was named by the Romans in honour of their goddess Juno. The Saxons called it the feed-month, because it matured the meadows for the depasturing of cattle, and the mild or navigable month, because it rendered the seasons calm and propitious for the passage of their small and fragile sailing-craft.—July was originally designated by the Romans Quintilis or the fifth month; and it received its present name, by order of Mark Antony, in honour of Julius Cæsar. The Saxons called it hay-month, because it was the time of their hay-harvest, and meadow-month because it was the season of their meadow-grasses rushing up to flower.—August was originally designated by the Romans Sextilis or the sixth month, and it received its present name in honour of Augustus Cæsar. The Saxons called it barn-month, in allusion to its being the season of harvest.—September was named by the Romans from two words signifying "seven," and "a shower," the former alluding to its numerical place in the original Roman Calendar, and the latter to its forming the commencement of the rainy season. The heathen Saxons called it barley-month, and the Christian Saxons holy-month,—the latter in allusion to the numerousness or the prominence of religious observances.—October was called by the Saxons wine-month and winter-fall,—the latter in allusion to the approach of winter. November was called by them wind-month, in allusion to the storminess of the weather, and slaughter-month, in allusion to the slaughtering and salting of a large portion of flocks in consequence of the paucity of winter provender; and December was called by the heathen Saxons winter-month, in allusion to the frostiness of the weather, and by the Christian

Saxons holy-month, in allusion to the festal season of Christmas.

The pervading or controlling principle of a natural calendar is simply the law of the earth's yearly revolution round the sun ; and the direct development of it in the phenomena of meteorology, as well as the indirect development of it in the phenomena of animated nature and of vegetation, is what constitutes the seasons of spring, summer, autumn, and winter. See the article SEASONS. Some of its chief and most obvious displays in the animal kingdom are connected or identified with the migrations of birds, the transformations of insects, the pairing of quadrupeds, and the hybernization and awakening of reptiles and molluscs. Its displays in vegetation are at once numerous, intricate, and conspicuous. "Heat, like light," observes Keith, "acts as a powerful stimulus to the exertion of the vital energies of vegetables. Seeds will not germinate at a very low temperature, even though placed in a proper soil. Hence, such as are self-sown, as by dropping from the plant in winter, do not generally come up till the spring, when the temperature has been raised to some considerable height by the rays of the returning sun. The same thing happens in the case of the development of the leaves, flowers, and fruit. They do not protrude themselves simultaneously, but at different periods of the spring or summer, dependent, as it would appear, upon temperature. This forms the foundation of what Linnæus has poetically styled the *Calendarium Floræ*, that is, *Flora's Almanack*. It embraces the several periods of the leafing and flowering of plants, together with that of the ripening of the fruit. * * Such are the primary facts on which a *Calendarium Floræ* should be founded. They have not hitherto been very minutely attended to by botanists ; and perhaps their importance is not quite so much as has been generally supposed ; but they are at any rate sufficiently striking to have attracted the notice even of savages. Some tribes of American Indians act upon the very principle suggested by Linnæus, and plant their corn when the wild-plum blooms, or when the leaves of the oak are about as large as a squirrel's ears. The names of some of their months are even designated from the state of vegetation. One is called the budding-month, and another the flowering-month ; and the autumn is designated by a term signifying the fall of the leaf. Thus the French revolutionists were anticipated even by the Indians in their new names for months and seasons."

Artificial calendars, both in the sense of almanacs, and in the practical and important sense of registers of natural appearances and out-of-door work peculiar to the respective seasons and parts of seasons, are now so numerous that a mere reference to two or three of the best might be quite sufficient for the purposes of many of our readers. Yet a calendar of our own seems indispensable both for the completeness of

our work, and for the guidance of such readers as have not access to separate calendars. We shall briefly notice some of the chief phenomena and operations of each month ; yet must not be considered as either depicting all the phases of the seasons, or presenting a complete catalogue of the duties of farming and gardening. Our calendar can affect no higher aim than to exhibit meagre specimens of seasonal phenomena, and suggest a few leading hints for connecting these with cultivation. "Our notices under each month," to adopt the words of Loudon, "must extend only to a few of the leading features of country work. To attempt to insert everything or even most of the things that require attending to, we conceive impossible, and, if it could be done, quite useless. A man will always act better when guided by his own judgment, than when following implicitly that of another. Calendars should only be considered as remembrancers, never as directories." Besides, instructions as to the proper timing of every operation of any importance, and of the management of each particular crop or plant, are given so fully in the articles on the several operations and crops and plants, that anything more in this place than mere general indication would be a sheer waste of words. Yet even as a brief list of hints, a meagre monthly summary of duty,—a Calendar is not a little valuable. "At the beginning of every month," remarks Arthur Young, "a good farmer, whether he has or has not a Calendar, is obliged to reflect on the work he has to perform in that month ; he ought to foresee the whole at once, or it is impossible he should make a proper provision for its due performance. I leave it to any one to judge if such an estimate of monthly business can be gained so easily, completely, or systematically, without such an assistance to the memory as is afforded by a Calendar ; and even if a Calendar but once a-year gives intimation of some important work, which might otherwise be forgotten, its worth must be acknowledged." The almanac time of any one Calendar can obviously adapt itself to only one set of latitudes, elevations, soils, and climate ; and requires to be so modified by readers, in other sets of these circumstances, as to become adapted to their own purposes. We adopt, as our average, the latitude, low situation, and well cultivated lands in the immediate vicinity of London ; and readers may easily adapt this average to their own circumstances, simply by reckoning the phenomena and the operations of spring four days later for every 70 miles north of London, or for every 600 feet of higher elevation than that of London, or for any cooling effects of soil and exposure which may be equal to the removal northward of a degree of latitude. Thus a low, flat, and excellently cultivated soil 350 miles in a straight line north of London, is, in all respects, twenty days later in spring than the soil to which our calendar applies ; an excellent arable soil, at the same

distance north, and with a southerly exposure, but having an altitude of 600 feet above sea-level, is twenty-four days later; an excellent arable soil, at the same distance north, and at 600 feet of altitude, but with a northerly exposure, may be twenty-eight days later; and a sour, spouty, undrained soil, situated in all respects like this last, may be fully thirty-two days later.

JANUARY.

Phenomena.—January is generally the coldest month in the year. The thermometer usually ranges, in this month, between 20° and 50° ; it has sometimes fallen to 12° or 10° , or even so extremely low as two or three degrees below zero; it has occasionally risen so high as 58° , or, in one recorded instance, to 64° ; and it probably has a mean height, on the average of many years, of about 33° . In severe seasons, the maximum of cold frequently occurs about the middle of the month, and is, in many instances, followed by such sudden rise of temperature and accompanying fall of rain as to occasion great and mischievous freshets from the melting of the snow. The barometer, in January, has a mean range of 1.50 inches, and a mean height of about 29.80. Snow or rain falls, in the average of many years, on between 14 and 15 days of January; and frost prevails during a considerable majority of the nights. The quantity of rain varies between one-tenth of an inch and nearly $3\frac{1}{2}$ inches; and the quantity evaporated during the month is about half an inch. In ordinary winters, January has a great prevalence of westerly winds; and in very mild winters, it is often characterized by high winds from between the south-west and the north-west, accompanied by frequent rains.

In the first week of January, the *laurustinus* continues to bloom from December, and sometimes so many as twelve or twenty species of our ordinary flowering plants are scantily and unnaturally in bloom, either by prolongation from autumn or by anticipation of spring; in the second week, the hazel begins to show its catkins, the honeysuckle begins to bud, and the Christmas rose and the winter aconite burst into bloom; in the third week, the chickweed and the daisy expand freely into flower, and the primrose, the polyanthus, and sometimes the auricula show some bloom in sheltered situations; and in the fourth week, the mezereon begins to bloom, the pansy and the sweet-scented violet expand, and the white butter-bur, the sweet-scented coltsfoot, and the archangel show a considerable quantity of flower. The most frequent or prominent flowers and fruits of the month, are, in the parterre, winter aconite, Christmas rose, primrose, polyanthus, wallflower, alpine alyssum, periwinkle, cyclamen, violet, anemone, crocus, and perennial navelwort; in the shrubbery, *laurustinus*, *arbutus*, *pyracantha*, Glastonbury thorn, *alaternus*, *pyrus japonica*, mezereon, and spurge laurel; and in the greenhouse, hyacinth, jonquil, polyanthus-narcissus, mignonette, lily of the valley, pink, rose, tulip, geranium, and a profusion of Cape heaths.

In the first week of January, earthworms and some species of *helicidæ* or common garden snails make their appearance; in the second week, the wagtail appears, and the redbreast, the mistle-thrush, and the nuthatch, make attempts at song; in the third week, the lark challenges attention; and in the fourth week, some common house flies appear, the hedge-sparrow and the large titmouse sing, and garden snails and slugs become numerous in the warmer parts of the garden. "The groves may be voiceless; no gushes of song ring from the copse or greenwood; but the feathered creation is still active, and in many spots their numbers greatly exceed those of spring or summer. Urged by hunger, millions

upon millions,—countless multitudes, come pouring down upon us from the frozen realms of the north, where the sources of vegetable life are completely locked up, and where, consequently, it is impossible for them to exist. Amongst these are vast numbers of the *tringæ* (sandpipers), *anatidæ* (ducks, swans, &c.), and a vast number of hard-billed birds, such as fieldfares, redwings, &c. The great period of migration takes place from September till November, according to the latitude the birds have summered in, and the severity of weather experienced in the north. But it is the web-footed tribe which more particularly fall under the notice of the sportsman and the naturalist in this month. The great bulk of these visitants have arrived in November, but the weather on the coast being still open, they resort to the sand-banks and mud-flats at the debouch of large rivers, where they live upon the small fish, bivalves, and crustacea, which abound there, as well as upon the more tender algæ or sea-weed. The north-eastern winds which come sweeping over the ocean at this time drive them from the open sea, and they flock to the first land they make, distributing themselves in ditches, rivers, and swamps, and, in very severe frosts, confining themselves to large rivers or unfrozen springs. Here, the sportsman, who has no easy task of it at this season, in the spots which these birds frequent, may occasionally start a mallard, a widgeon, a teal, golden-eye, shoveller, pintail, or other bird, and, if the weather be unusually hard, a wild-swam or wild-goose."

The Farm.—In January, the ewes of some breeds of sheep, begin to lamb, and require an unusual degree of care. In storms, deep snows, and very wet weather, sheep should be baited on hay; and, during severe or prolonged frosts, they may be very advantageously fed on cabbages. On enclosed farms which support stock chiefly on the grasses, and do not make large provision in turnips or cabbages, such ewes as have in former years lambed in January should be drawn off from the flock, and put into rouen, to give early lamb. Cattle which run loose in the yard or yards, should be well attended to, regularly supplied with straw or other provender, kept upon a dry and clean litter, and always permitted access to abundance of pure water. The thrashing should be so proportioned to the stock of lean cattle, as to make the supply of straw for the yards always sufficient, and yet equally distributed throughout the winter. Straw for provender ought to be cut into chaff, and mixed with hay; and when cattle are in low condition, they should receive some more nutritive food, particularly turnips, cabbages, and well-saved bean-straw. If any cows are to calve in January, they ought, for about a month before calving, to be taken into the house from the straw-yard, and baited twice a-day with potatoes, cabbages, turnips, carrots, or some other varieties or mixture of green food. Last year's calves should now receive hay and either turnips, carrots, or potatoes,—and should be thoroughly well-fed, and kept perfectly clean by means of litter; for, if otherwise treated, they will be arrested in their growth, and will not derive adequate advantage from even the best feeding of the following summer. Yearling calves should feed apart from two-year-old steers and heifers, for they require more nourishing food. The winter fattening of cattle is at the busiest in January; and may be conducted either by carrying turnips and other green food to a very sound and dry grass-field, or by placing the food in mangers under open sheds in the farm-yard, or by giving it in the house in the manner of strict stall-feeding. The first of these methods requires dryness of climate, shelteredness of situation, and very eminent soundness of pasture, and hence can very seldom be advantageously practised; and the second and the third require a profuse use of litter, and the most thorough attention to cleanliness

and ventilation. January is a principal season for the bringing forth, the rearing, and the fattening of swine, yet more for the first of these than for the second and the third. A sow and her pigs must be kept in a sty, and fed with dairy-wash out of cisterns, and with potatoes, parsnips, carrots, cabbages, or other food stored for them in autumn; and they ought always to be well littered, and perfectly clean. Though winter pigs are often pronounced unprofitable, they will certainly yield a fair return if treated with great care, and fed with due regard to economical accumulations from the dairy and the store-houses. Last year's early pullets begin to lay about the first of January, or even a few days earlier; and such as seem backward to lay should be fed with buckwheat or barley.

A most important general rule in farming is to keep horses constantly employed; it is altogether indispensable in order to avert loss from the great expense of purchasing and feeding horses; and, in no month of the year, is it so difficult of observance, or does it require such multiplicity of accommodation, as in January. The soil is, for the most part, either bound up with frost or saturated with moisture; yet when at any time open and comparatively dry, it may be worked with the plough. During open though wettish weather, all practicable carting upon roads may be done, particularly in communicating with the market-towns, and in bringing home distant manures; during frost, the carting of manure on the farm itself, and especially the removal of composts, ought to be performed; and during either open or frosty weather, the bringing home of fuel and of mineral manures, and cart-work over all the most facile parts of the farm may be extensively practised. January is eminently a season of thrashing, whether with machinery or with the flail; and it is also a principal season for hedging, ditching, and draining. See the articles *THRASHING*, *FENCES*, and *DRAINING*. In peculiar circumstances, as when the weather is very open and genial, or when a dry January follows a wet December, or when the land, throughout the preceding autumn, was saturated with moisture, a field sowing of Mazagan beans may be made in January. Woodlands should now be drained and opened; and woods and coppices which are not valuable for their bark may be felled. All water-cuts made in autumn for keeping arable fields dry should now be examined, and freed from obstructions of weeds, ice, or snow. Lime-burning, when part of the economy of a farm, may be performed at any time in January, or throughout the winter. If snow be not very deep and falling, the quarrying of stones and the building of enclosures for mountain improvement may proceed.

The Kitchen Garden.—The produce of the open ground of the kitchen garden available for January, comprises potatoes, turnips, Jerusalem artichokes, beet-root, parsnips, carrots, borecoles, cabbages, savoys, cabbage-sprouts, broccoli, cauliflower, spinach, cardoons, celery, endive, eschalots, horse-radish, garlic, onions, leeks, rocambole, sage, scorzonera, salsafy, skirret-root, and thyme; and that of the hotbeds of the kitchen garden comprises sea-kale, asparagus, cucumbers, lettuces, rhubarb-stalks, mint, mushrooms, mustard, and cresses.

A small sowing of early horn carrots may be made, in dry and open weather, in the beginning or middle of January, in a warm spot of the garden, to come into use a little before the general spring-sown crop.—A small sowing of short-topped radishes may be made any time in January, and one of salmon-radishes in the latter part of the month; but both must be made in open weather, and on a warm spot, with exposure to the sun. At any time of the month, a little spinach may be sown for early spring use. In the latter part of the month, some curled parsley may be sown for

early spring use. Toward the end of the month, in mild weather, strong plants of any of the larger sorts of cabbage may be transplanted, either at distances of 2½ feet for full growth, or at half these distances for thinning. In the beginning of the month, if the work have previously been omitted, cabbages, borecoles, savoys, and other brassicas may be transplanted to the head to produce seed. On any dry day previous to frost, such celery as requires the operation should be earthed up. On any dry day, which has been preceded by a little drought, some of the largest endives may be prepared for blanching. In the early part of the month, potato onions should be planted. In mild open weather, small sowings of any of the early sorts of garden beans may be made; and both in the beginning and toward the end of the month, in open weather, some ground should be prepared for the main crops of Sandwich, Windsor, and other broad beans. In the beginning of the month, a sowing of hotspur pease may be made on a warm plot of ground, to succeed the sowings of November and December. In dry weather, after a few days of drought, advancing crops of autumn and winter-sown beans and pease should be earthed up. At various times of the month, hotbeds may be prepared for cucumbers and melons, sowings of these plants may be made, and the seedlings of previous sowings may be pricked out. In mild and dry weather, lettuces may be sown or may be transplanted to force; and, according to vicissitudes of weather, lettuces in frames or under hoop-arches must be laid open to the air, or thoroughly covered from the weather. At any time of the month, hotbeds may be made for forcing asparagus, preparations effected for forcing rhubarb, and small hotbeds made for mint, tansy, and similar plants. Throughout the month, careful attention must be paid to mushroom beds; and in suitable weather, new beds may be made,—though these will always be inferior to beds made in autumn.

The Fruit Garden.—The fruits of home growth available for use in January are almonds, grapes, chestnuts, walnuts, filberts, several varieties of pears, and numerous varieties of apples.—In January, all previously unpruned apple-trees and pear-trees upon walls and espaliers should be pruned; plum-trees and cherry-trees, on walls and espaliers, should be pruned and nailed; old gooseberry-bushes and currant-bushes should be pruned, and new ones may be planted; raspberry-bushes should be pruned and planted; fruit-trees, whether for walls, espaliers, or standards, may be planted; old standard fruit-trees should be pruned; newly-planted fruit-trees should be supported with stakes, and have their roots protected by coverings of litter; and strawberries may be planted on a hotbed, to produce fruit for use in March or April.

The Flower Garden.—In open dry weather, in January, anemones, ranunculuses, tulips, snowdrops, jonquils, gladioluses, fritillaries, crocuses, hyacinths, bulbous irises, narcissuses, and other similar hardy or half-hardy bulbous roots may be planted; roses, lilacs, honeysuckles, and most other hardy flowering shrubs may be planted; the suckers of roses, lilacs, and other hardy shrubs which are most easily propagated from suckers, may be taken off and transplanted; edgings of thrift or boxwood may be made round beds or along borders; hardy trees, whether ornamental or economical, for the lawn or for the forest, may be planted; and cuttings of honeysuckle, and of many kinds of flowering shrubs and ornamental trees, may be successfully placed in the ground for propagation. In severe weather, whether frosty, snowy, or excessively rainy, potted auriculas should be placed in frames or under mat-awnings; fine potted carnations should be covered with glass if in frames, or with mats if in a bed of compost beneath an arch of hoops; beds of hyacinths, of fine tulips,

and of the choicer kinds of other flowering bulbs should be covered with awnings, or with fern, straw, or long dry litter; choice perennial-rooted, hardy flowering plants, such as double stocks, double sweet-williams, double chrysanthemums, male pinks, and the hardier and finer verbenas, should be protected; and pots or boxes of choice seedlings should be placed in a frame or under glasses. In open weather, lawns and grass walks should be rolled and frequently rolled; and portions of them which have been broken or too deeply bared, may be mended with lifted and squared pieces of sound sward from pasture fields. —The culture of greenhouse and hothouse plants is dependent, not wholly on the season of the year, but partially on the intentions of the gardener as to protecting and forcing; and—with much more appropriateness than could be done in the present article—it will be discussed at one view in the articles *GREENHOUSE* and *HOTHOUSE*.

FEBRUARY.

Phenomena.—The weather of February in any one year may be extremely variable; and that of this month in different years sometimes exhibits the most discrepant and even opposite characters. In a general view, it is a fitful succession of frosts and thaws, of drenching rains, violent storms, and genial calms; yet it may in one year be nearly all stern frost,—and in another, nearly all genial and vernal mildness. In six years, between 1807 and 1839, it was intensely cold; in other six, it was extremely rainy and tempestuous; and in four, it was calm, pleasant, and comparatively dry and warm. The thermometer, in districts near London, has been recorded to range, in February, between 60° of Fahrenheit and 5° below zero. The barometer has a mean range of 1.43, and a mean height of about 29.85. The depth of rain is exceedingly variable, not only in different years, but in different and nearly-adjacent localities; and the amount of evaporation is very nearly, if not quite, an inch. The prevailing winds of the month, in severe seasons, are from between north and north-west; and in mild seasons, from between south and west.

The particular character of the weather regulates, in a great measure, the classification or grouping of the birds which visit us. When frost prevails, our rivers and ponds continue to be frequented by the different kinds of the duck tribe; and our shores and sandbanks are the resort of innumerable waders, including the sandpipers, the *tolani*, and others. But when mild though showery weather prevails, our fields are visited by numbers of vermivorous birds, and particularly by peewits and plovers;—and in the first week, larks, throats, and chaffinches sing, earth-worms appear on the surface of the soil, and bees, gnats, and numerous small insects leave their retreats or achieve their final transformations, and sport in the sunbeams and among the opening vegetation; in the second week, linnets are numerous, and geese begin to lay; in the third week, house-sparrows begin to build, and rooks begin to pair; and in the fourth week, the wood-lark and the black-bird sing, and the partridge begins to pair.

In the first week, when the weather is mild, and has been preceded by a mild January, the polyanthus, the primrose, the snowdrop, the violet, the whin, and the white deadnettle are in flower, and several flowering shrubs, particularly the honeysuckle, the elder, and several kinds of roses show bloom; in the second week, the female catkins of the hazel appear, and the dandelion and the creeping crowfoot begin to flower; in the third week, the catkins of many of the willows and poplars appear, and the stems of crown imperials and early tulips push boldly up, in the open ground, toward their flowering condition; and in the fourth week, groundsel, wood-strawberry, and several species of veronica are in

flower, and some varieties of gooseberry-bushes, peach-trees, apricot-trees, and thorn-trees, inclusive of the common hedge hawthorn, begin to expand their buds.—The most conspicuous blooms, in the parterre, are crocuses, snowdrops, anemones, primroses, polyanthus, wallflowers, cyclamens, Christmas roses, periwinkles, alpine alyssums, perennial adonises, daisies, daffodils, hepaticas, Persian irises, and dog-tooth violets; in the open shrubbery, laurustinus, daphne mezereum, rhododendron atrovirens, cydonia japonica, pyrus japonica, phillyrea, cornelian cherry, almond, cherry plum, and Glastonbury thorn; and, in the greenhouse and conservatory, hyacinths, tulips, polyanthus-narcissus, primula verticillata, pinks, mignonette, lily of the valley, geraniums, cinerarias, roses, some amaryllidæ, enkianthus quinqueflora, rhododendrons, azaleas, kalmias, camellias, five or six kinds of acacias, and many kinds of Cape heaths.

The Farm.—Stock ewes now begin to lamb, and must be very carefully attended. The shepherd ought, throughout the lambing season, to sleep close to the flock, that he may be ready to tend and assist any ewes which he sees near lambing, and may, if necessary, give the lambs some warm cow's milk. The ewes ought to be kept away from wet yards, and well attended to as to at once warmth, cleanliness, and proper feeding. Ewes which have lambed should be drawn from the flock, and placed upon rouen or new grass pasture. Sheep which are feeding on turnips ought now to receive oil cake, not only for their own sake, but for the benefiting of the land. All live stock now require special attention; for, in February and March, they are usually more liable to disease and damage than in any other part of the year.

Beans, pease, vetches, cabbages, spring wheat and black oats may now be sown. The latter end of the month, if the weather be open, is the proper time for sowing kohlrabi. Part of the preparation for sowing carrots in next month should now be made. The general farm labour, for the economical employment of both men and horses, which was proper for January, should be continued throughout February,—ploughing during open weather, and thrashing and carting during frost. If north-east winds begin to blow toward the end of the month, the paring and burning of grass land, when the principle of it has been approved and adopted, should be carried into practice. Such borders of ploughed fields as are encumbered with the clearings of ditches or with accumulations of soil by the plough and the harrows, or such as are in any other way raised and irregular, and especially such as are overrun with rank weeds and straggling bushes, ought now to be brought into an orderly condition, clean, level, and in perfect keeping with the well-tilled expanse of the general surface of the fields. Underwood, as in the preceding month, may still be very profitably felled. The instant any field is thoroughly ploughed, care must be used to keep it free from stagnant water and from the desolating sweep of heavy rains, by means of water-furrows. Top-dressings of wood-ashes, lime, malt-dust, or other appropriate surface manure, may now be spread upon grass lands; but all such top-dressings ought to consist principally of alkaline and earthy elements, or to be of a nature which will sink into the soil, there to undergo slow chemical decomposition, and not be speedily dissipated into aeriform conditions by lying in immediate contact with the atmosphere. Top-dressings of salt, wood-ashes, soot, or any similar manure, which possess the double property of aiding the crop and killing the grub, may now be given also to green wheat.

Great care ought to be used throughout February, to keep the beasts of the farm-yard constantly.

cleanly, and abundantly littered; and if the stock of straw or other litter upon the farm itself appear to be insufficient or stinted in quantity, agreement ought immediately to be made with some more provident neighbour for a regular weekly supply. Broken fences in boggy or swampy situations, may now be mended with truncheons of alder or of the most suitable kinds of willow or poplar; and either narrow belts along the sides of such hedges, or spots and expanses of such open swampy ground as cannot speedily be drained and tilled, may now be planted with osiers and other sorts of willows. Irrigated meadows now require nice attention; for if the water be permitted to overflow them for many days in succession, a white scum of a nature very destructive to the grass is generated; and if the water be then turned off, and the land exposed in its wet state to a night of severe frost, a large proportion of the tender grass will be destroyed. If a farmer have anywhere a piece of very deep, rich, dry, sound, friable, sandy loam, very deeply ploughed in autumn, and thoroughly pulverized and mellowed by the action of the winter's frost, he may, in favourable weather, about the 12th of February, sow it, if he pleases, with parsnips,—the most valuable of all the roots which a farmer can cultivate. If land designed for a potato crop be tolerably dry, even though it was well tilled in autumn, it may now receive a ploughing preparatory to the planting of the crop in the beginning of March. The lime-kiln may be plied in any part of February; and lime may be carted and spread whenever the carts can move without damage to wet soils. The cropping of pollards for fuel should cease toward the end of February. The sowing of sainfoin should, if possible, be completed in February, and ought never to be deferred beyond the beginning of March.

The Kitchen Garden.—The produce of the natural ground of the kitchen garden available for use in February comprises potatoes, turnips, parsnips, carrots, borecoles, cabbages, savoy, broccoli, Jerusalem artichokes, beet-root, alexanders, celery, chervil, parsley, salsafy, sage, scorzonera, endive, sorrel, eschalot, lettuce, garlic, onions, leeks, horse-radish, and rocambole; and that of the hot-beds or forcing appliances of the kitchen garden comprises rhubarb, radishes, sea-kale, cresses, mint, kidney-beans, asparagus, mustard, cucumbers, and mushrooms.

About the middle or latter end of February, cabbages, borecoles, and savoy should be sown for use in July and in autumn. In any time of the month, when the weather is open, the autumn sown cabbages and other hardy garden brassica may be transplanted to their final situation. In dry open weather, late and strong celery should be earthed up; and in the latter part of the month, a small sowing of upright solid celery may be made, on a warm border, for an early crop. Both in the beginning and in the latter part of the month, sowings may be made, in a warm border, of short-topped radish and salmon-radish. In the beginning of the month, spinach may be sown; and throughout the month, advancing crops of it should be thinned and well weeded. In the beginning of the month, cos lettuces, for forward growth, may be sown in a frame; in the middle, several sorts may be sown on a warm border; and in the end, in mild weather, seedlings in frames should be thinned, and the thinnings planted in the open ground. In the latter part of the month, an early crop of carrots and the main crop of parsnips and of beets may be sown, the remains of last year's crops drawn and stored, and a few of them transplanted two feet asunder to run to seed. In the middle or toward the end of the month, onions and leeks may be sown. In open weather, successions of pease and beans may be sown, and advancing crops must be earthed up. In the latter part of the month,

thyme, salsafy, hyssop, scorzonera, savory, marjoram, and parsley may be sown; and at any time, in mild open weather, borage, angelica, coriander, chervil, lovage, burnet, and other similar plants may be sown, and garlic, rocambole, and eschalots may be planted. In the latter part of the month, and on a warm border, a few potatoes, for an early crop, may be planted, and some early Dutch turnips may be sown. In any open weather, horse-radish and liquorice may be planted.

In the end of the month, on a slight hotbed, some early white broccoli may be sown. In the beginning or middle of the month, the raising of early melons and cucumbers, may be commenced or repeated; the plants of former sowings, if they have escaped injury, should be pricked out and planted in larger and final hotbeds; and all sound and rooted plants, if hitherto untopped, should now be pruned of the top of their first runner-bud. At any time of the month, hotbeds may be made for forcing asparagus, or for the raising of early kidney-beans; and throughout the month, mushroom-beds must be well protected from frost and heavy rains. In all mild weather, cauliflower plants in frames should receive perfectly free airing; and in fine settled weather toward the end of the month, a few of the strongest may be transplanted to their final situation in the open ground. Weekly, in cucumber frames, or toward the end of the month on warm borders in the open ground, cresses, radishes, and other small salad plants may be sown.

The Fruit Garden.—The principal home-grown fruits available for use in February are filberts, walnuts, chestnuts, almonds, and some kinds of pears and apples. In February, the pruning of standard fruit-trees may at any time be attended to; the pruning of pear-trees and apple-trees on walls and espaliers ought to be completed; the pruning of vines ought, as early as possible, to be performed; and the pruning of raspberry, gooseberry, and currant bushes, if previously unattended to, should now be speedily done. In this month also, gooseberry and currant plants may be propagated; a few potted early green gooseberry bushes may be placed in the forcing-house; strawberry plantations should be cleared, and spring-dressed; all sorts of hardy fruit-trees may be planted; newly planted standard fruit-trees should be supported with stakes; fruit-tree and fruit-bush borders should be dugged and neatly dressed; fruit-trees on hot-walls or within houses, particularly cherries, plums, peaches, apricots, nectarines, figs, and vines, may be steadily and constantly forced; the seeds of apples, pears, plums, cherries, and other hardy fruit may be sown for raising grafting-stocks; new plantations may be made of stocks to graft and to bud upon; grafting, in any of its several methods, may be commenced, in mild weather, in the latter part of the month; and syringings, sweepings, and washings of fruit-trees may be practised for the destruction of insects.

The Flower Garden.—Toward the end of February, in dry and mild weather, many kinds of hardy annuals may be sown in the open ground, particularly adonis flos, lavatera, mallow, sunflower, hawkweed, sweet pease, lupines, Venus' looking-glass, rocket larkspur, dwarf lychnis, Venus' navelwort, Lobel's catchfly, candytuft, convolvulus, chryseis, cerinthe, echium, nigella, poppy, scorzonera, nasturtium, and ten weeks' stock; and so early as the middle of the month, such tender annuals as cockscombs, balsams, tricolors, and capsicums may be sown upon hotbeds.—In severe weather, whether frosty or excessively rainy, beds of the choicest bulbous-rooted plants should be protected. In the beginning of the month, some choice annuals, for early bloom, may be sown in pots, and placed in the hothouse; and some pots of pinks, sweetwilliams, carnations, ane-

mones, hyacinths, and other favourite hardy perennials, whether fibrous-rooted, bulbous, or tuberous, may, for early bloom, be placed either in the hot-house or in hotbeds. In mild and open weather, hardy, herbaceous, fibrous-rooted plants, whether biennials or perennials, such as stocks, rockets, saxifrages, hepaticas, violets, primroses, gentians, phloxes, monkshoods, potentilla, and columbine, may be transplanted to any situation where they are wanted, and, in most instances, may be freely separated into portions by the parting of the root-clods. Such auricula plants as are in pots should be dressed; and such choice ones as are in the open ground should be protected by mats or glass from severe weather. The seeds of auricula, polyanthus, and other primulæ, may be sown either in pots, in boxes, or in a very warm and well-sheltered part of the open border. In mild weather, about the end of the month, plants of carnations and pinks, raised from layers, may be removed and planted. In any open weather, most kinds of hardy, flowering, deciduous shrubs, such as roses, spiræas, lilacs, jasmines, sumachs, laburnums, Guelder-roses, cistuses, honeysuckles, robinias, and scores of others, may be safely transplanted; the pruning of flowering evergreen shrubs may still be attended to, but ought now to be brought to a close; and both the planting of new edgings to beds and borders, and the mending of gaps in old ones, whether of box, thrift, double daisies, none-so-pretty, gentiana verna, or other plants, may now be most successfully and neatly performed. Throughout the month, lawns and grass walks ought to be kept perfectly clean; and in dry open weather, they should be repeatedly polled and rolled.

MARCH.

Phenomena.—March is usually characterized as the windiest month in the year; yet it very frequently partakes of the same fickleness, uncertainty, and contrasts of character as February. Storms and strong gales occasionally blow at all times of the month; and tempestuous winds, which are popularly though very absurdly designated equinoctial gales, very often occur between the 17th and the 24th, and not seldom between the 24th and the end. Fierce storms, accompanied with destructive snowdrifts, have likewise repeatedly occurred during the first week of the month. In most years, the prevailing wind blows from the north-east, and is keen, cutting, unhealthy, dry, and powerfully evaporating; but in other years, it blows from the south-west, and is accompanied with excessive rains. The thermometer has a mean height of 42° , and usually ranges between 27° and 60° , but has been known to fall so low as 5° , and to rise so high as 70° . The extraordinary minimum temperature of 5° , however, occurred in 1845; and the minimum of previous years, so far as known to record, was 17° . The barometer has a mean range of 1.30, and a mean height of 29.87. The probable depth of rain, upon an average of many years, is $1\frac{1}{4}$ inch; and the probable mean evaporation is 1.3 inch, or very nearly equal to the depth of rain.

In the first week of March, the bay-tree, and two or three species of willow and of poplar, are in blossom, numerous species of cone-bearing trees are in full flower, and hawthorns, poplars, gooseberry-bushes, and various other trees and shrubs are green with young foliage; in the second week, crocuses, hepaticas, and numerous primulæ, are in flower, and the elder, the pilewort, the honeysuckle, the creeping crowfoot, and some kinds of roses are in leaf; and in the third week and fourth week, a multitude of shrubs and herbs are covered with foliage, and a comparative profusion of spring-flowering plants are in bloom. The most conspicuous flowers of the

month are, in the shrubbery, mezereon, daurian rhododendron, small-calyxed rhododendron, almond, cydonia japonica, mahonia, manna-ash, cornelian cherry, sea buckthorn, scarlet-flowering maple, peach, spurge laurel, and Spanish traveller's-joy; in the parterre, wallflowers, violets, auriculas, polyanthus, primroses, anemones, crocuses, cyclamens, crown-imperials, daffodils, daisies, dog's-tooth violet, pilewort, squills, ranunculuses, van-thol tulips, hyacinths, hepaticas, gentians, Persian irises, and various others; and in the greenhouse and conservatory, jonquils, pinks, carnations, numerous amaryllidæ, honeysuckles, roses, polyanthus-narcissus, kalmias, rhododendrons, camellias, lilacs, acacias, cape heaths, and many others.

In the early parts of March, earthworms, slugs, and snails engender, the small tortoise-shell butterfly appears, and the tomtit, the ring-dove, the white wagtail, the jackdaw, the yellow wagtail, and the brown wood-owl, attract attention by either their appearance, their song, or their peculiar habits; in the middle parts of the month, numerous flies appear, the turkey-cock gobbles, and the marsh titmouse begins his song; in the latter part of the month, the common flea appears, the field cricket leaves its retreat, the yellow-hammer, the goldfinch, and the green woodpecker sing, and the rook, the raven, and the house-pigeon build their nests; and throughout the month, the redwing, the woodcock, the fieldfare, the palmipedes, and some others of our visitors, leave our shores, and pass away to the shores of the Baltic, to Norway, to Siberia, and to the cold parts of North America.

The Farm.—In March, all sheep, whether ewes, lambs, or fatting sheep require to be extremely well kept; for if they be insufficiently fed or carelessly tended at this season, all the money previously expended on them will be nearly thrown away. Ewes, in particular, ought, previous to lambing, to be fed on carrots, mangel-wurzel, and hay, and, after lambing, to be transferred, along with their young, to sound new grass; and they should be kept in a warm, dry, well sheltered, and perfectly clean condition. Throughout the month, all cows and lean and young cattle should be kept close in the farm-yards, and on no account allowed to wander over any of the fields; for, when they find their way into a grass field, they not only break the sward and make a waste of manure, but, by obtaining a mouthful or two of sweet young grass, contract a repugnance to the dry and somewhat artificial food of the yards. All cows and mares which have quite recently produced young, should be carefully and nicely attended to, for food, for shelter, and especially for ventilation and thorough cleanliness; and all yard-fed or stall-fed fatting beasts should be well cared for as to food, water, and litter. Colts should receive hay; and horses ought to be constantly on full work, and daily receiving a full allowance of hay and corn. "March," says Arthur Young, "is a month in which carrots are in full perfection; they have now evaporated much of their moisture, and easily bend in the hand, being as it were withered. Then every ounce is nourishment, and they are fully as hearty as oats; insomuch that horses that have had a month's carrots will refuse oats. To provide this root in ample quantity for February, March, and April, is an object that ought never to be omitted." Poultry, during March, require much attention; their boxes or lockers should be so often replenished with hay or straw as to secure perfect cleanliness; their houses should be so cleansed and lime-washed as to be kept free from vermin; their supplies of corn, buckwheat, boiled potatoes or other food, should be good and regular; and free access ought to be constantly afforded them to a gravelled yard, to clean water, and to a range over grass.

If the soil or situation of a farm be unsuited to the sowing of barley in February, or if the turnips on the field intended for it were not eaten by sheep, or drawn and carted in sufficient time to admit of February sowing, March ought to be the principal, and if possible the sole period for the sowing of barley; for, all other circumstances being equal, barley sown in March will always be a better crop than barley sown at a later period. March excels every other season also as a seed-time for white oats; and the early part of it competes with the latter part of February, the character of being the best seed time for sainfoin. All sorts of pease not sown in February should be sown in March; beans and parsnips, if prevented by adverse weather from being sown in February, ought now to be sown without delay; and successive crops of tares or vetches ought likewise to be sown. Any time in March will suit for sowing carrots; and the latter part of the month, after some days of dry weather, is suitable for planting potatoes. At any time, in favourable weather, kohlrabi may be sown for transplanting in June; in the beginning or middle of the month, lentils may be sown; at any time, in tolerable weather, chicory may be sown, and mangel-wurzel dibbled in; and about the middle of the month, woad, if it should ever again come into requisition, may be sown.

The labours of the barn, for the supply of straw to the yard, and of corn to the market, are continued throughout March from January and February. The requisite tillage, whether entire or finishing, for the various sowings which we have mentioned, requires to be performed. The turnip fallow should now be thoroughly stirred, cleaned, and pulverized with the grubber. The rising wheat crops ought, without any delay, to be cleaned and stimulated by scarifying or hand-hoeing. All newly ploughed or newly sown fields should be immediately water furrowed with the plough and scoured with the spade. The water should be taken off irrigated meadows for about a week in dry weather, in order to allow the sward to become sufficiently firm to bear the tread of sheep; and, if the first week of feeding upon these meadows should prove cold or rainy, a little hay should be given to the ewes in the evening to intermix with their moist food. Special efforts should be made in March for destroying moles. Top-dressings may now, as in February, be given to green wheat. The burning part of the operation of paring and burning may now be conducted on any scale. The only crops for which composts and farm-yard dung should now be carted are potatoes and cabbages. March is the season for the nice, intricate, and operose work of planting hops. Grass and clover fields intended for mowing ought now to be stone-picked.

The Kitchen Garden.—The produce of the natural ground of the kitchen garden available for use in March comprises potatoes, turnips, carrots, parsnips, cabbages, savoy, borecoles, cabbage-sprouts, garlic, onions, leeks, alexanders, asparagus, thyme, water-cress, horse-radish, rocambole, sage, salsafy, broccoli, borage, endive, cress-parsley, beets, eschalots, balin, cardoons, burnet, celery, chervil, marjoram, mint, corn-salad, Jerusalem artichokes, savory, lettuces, spinach, sea-kale, scorzonera, and sorrel; and the produce of hotbeds or other forcing appliances in the kitchen garden includes pease, early potatoes, rhubarb, cresses, asparagus, lettuces, kidney-beans, mustard, mushrooms, and cucumbers.

In March, transplant all kinds of hardy brassicæ; transplant to the open ground cauliflower seedlings from frames; sow in the open ground cabbages, savoy, borecoles, broccoli, lettuce, spinach, onions, leeks, parsnips, carrots, radishes, beet, asparagus, pease, beans, turnips, celery, chervil, coriander, parsley, borage, fennel, clary, orache, dill, bugloss, nasturtium, salsafy, scorzonera, marigold, sorrel,

skirrets, cardoons, burnet, savory, hyssop, marjoram, and thyme; sow in slight hotbeds cauliflower, purslane, basil, capsicums, love-apples, and kidney-beans; dress beds of asparagus and plantations of artichokes; earth up pease and beans; plant asparagus, artichokes, rosemary, lavender, rue, wormwood, chives, mint, potatoes, and Jerusalem artichokes; and maintain proper heat upon growing melons and cucumbers,—transplant, to new hotbeds, in the beginning of the month, the seedlings of melons and cucumbers sown since the latter part of January,—make in either old or new hotbeds, in any time of the month, new sowings of melons and cucumbers for transplanting into beds, and, in the latter part of the month, new sowings for planting under hand or bell glasses.

The Fruit Garden.—The home-grown fruits available for use in March are few in number, and consist principally of apples, pears, walnuts, filberts, chestnuts, and almonds from last year's harvest, and forced strawberries from hotbeds.—In March, prune fig-trees, filbert-trees, apricot-trees, peach-trees, nectarine trees, and vines; protect the blossoms of apricot-trees, peach-trees, and nectarine-trees; propagate fig-trees, vines, filbert-trees, walnut-trees, and chestnut-trees; plant, early in the month, all sorts of hardy fruit-trees, which were omitted to be planted at the more proper season; train and prune young wall and espalier trees of apple, pear, plum, cherry, peach, and apricot; prune such gooseberry and currant bushes as were omitted to be pruned in the preceding month; dress such strawberry plantations as were previously neglected; continue the forcing of fruit-trees on hot walls; give liquid manure to young vines, peach-trees, and other tender fruiting shrubs and trees in pots; graft apple-trees, pear-trees, plum-trees, cherry-trees, and other kinds of fruit-trees; shorten the shoots of grafted or budded fruit-trees of a year's growth; and finish the present year's planting of fruit-tree stocks for grafting and budding.

The Flower Garden.—Such tender annuals as were sown in February should now be pricked out, and set in new hotbeds, or, in a few instances, in pots. Most kinds of tender annuals may be sown, at any time of the month, upon hotbeds. Half-tender annuals should be sown, about the middle of the month, on slight hotbeds. All kinds of hardy annuals may be sown in mild weather, and some kinds in even coldish weather, upon the open borders. Choice hardy perennial plants in pots, such as carnations, campanulas, and auriculas, should be dressed and receive some fresh soil. Choice auriculas, tulips, hyacinths, ranunculuses, and anemones, in the open ground, should be protected from frosts, keen winds, and excessive rains. Very fine hyacinths, with close spikes and ample petals, in the open ground, should be supported with sticks, and specially protected. Layered carnations and other layered plants, which were not attended to in February, should now be removed and transplanted. The planting of anemones and ranunculuses, for the present year, should now be completed. Most kinds of hardy, perennial, fibrous-rooted plants may be lifted, and, if necessary, have their root-clod divided, to fill vacancies in the borders, or to effect an improved distribution of heights and colours. Most kinds of hardy biennials and fibrous-rooted perennials may, in the latter part of the month, be sown in the open ground. The digging and dressing of the ground in shrubberies, and the pruning of all kinds of evergreen and flowering shrubs, should be completed early in the month. The transplanting of many kinds of deciduous flowering shrubs, as roses, lilacs, dogwood, dwarf almond, double-flowering cherry, guelder-rose, spiræas, sumach, honeysuckle, candleberry myrtle, snowberry, and laburnum, may still be safely effected; and edgings of box, thrift, pinks, double daisies, or none-so-pretty may still be planted. Dahlia tubers

may, in the latter part of the month, be planted on a mild hotbed or in the bark-bed of a hothouse. New lawns or grass walks may be made; gravel walks ought to be kept perfectly clean; edgings ought to be shaped into perfect regularity; borders, beds, and walks ought to receive a general spring dressing; and the whole garden ought to be cleaned, dressed, and decorated into the finest possible order.

APRIL.

Phænomena.—April is usually characterized as a month of alternate showers and sunshine; and it eminently partakes of the fickleness of March, but has far less windiness, and more sudden and frequent vicissitudes. The April of many years is constantly showery; and that of most is more or less showery; yet that of a few is constantly or almost wholly fair and sunshiny. Some days of the April of most years are very warm, and others very cold; and not a few of even the warmest days are followed by frosty nights. The thermometer has a mean height of about 46° ; it usually ranges, during the month, between 28° and 68° ; it has been known to fall so low as 20° , and to rise so high in the shade as 81° ; and it sometimes makes a range within twenty-four hours, or rather between 2 o'clock P.M. and midnight, of not less than 45° . A large proportion of the month is sometimes swept with keen easterly winds. The barometer has a mean height of 29.81, and a mean range of 1.25. The depth of rain, on an average of many years, is about 1.8; and the quantity of evaporation is about 2.2.

The succession of the leafing of trees is a much more extensive and interesting subject of observation in April than in any other month. A few of the most common species of shrubs, fruit-trees, and forest-trees, were observed by Stillingfleet to leaf in Norfolk as follows:—on the 1st of April, the birch and the weeping willow; on the 3d, the raspberry and the bramble; on the 4th, the brier; on the 6th, the plum, the apricot, and the peach; on the 7th, the filbert, the sallow, and the alder; on the 9th, the sycamore; on the 10th, the elm and the quince; on the 11th, the marsh-elder; on the 12th, the wych elm; on the 13th, the hornbeam and the quicken-tree; on the 14th, the apple-tree; on the 16th, the abele and the chestnut; on the 18th, the oak; on the 19th, the lime; on the 21st, the maple, the plane, the walnut, the beech, the robinia, and the black poplar; and on the 22d, the ash and the Carolina poplar. Around London, in the early part of the month, primulae, open-ground hyacinths, gentianella, ground-ivy, evergreen candytuft, pulmonaria, and most fruit-shrubs and fruit-trees are in flower; in the middle part of the month, many robinias, kalmias, andromedas, rhododendrons, daphnes, and other shrubby plants, as well as some herbaceous plants, come into flower; and in the latter part of the month, the larch is in leaf, tulips, fritillaries, and white narcissi are in flower, ivy-berries fall, and the beech and the elm are in blossom. Some of the most conspicuous flowers of the month, are, in the shrubbery, laburnums, cherries, almonds, lilacs, peaches, barberries, scorpion senna, cydonia, service-tree, rhododendrons, andromedas, daphnes, and kalmias; in the parterre, auriculas, fritillaries, violets, dog-tooth violet, peonies, primulae, jonquils, narcissi, irises, anemones, lychnis, fumatory, stocks, tulips, pilewort, saxifrages, daisies, cretan alyssum, crown imperials, columbines, ornithogalums, ranunculuses, and many others; and in the greenhouse, carnations, pinks, amaryllidæ, corraeæ, cactuses, cinerarias, geraniums, heaths, and a profusion of others, both herbaceous and shrubby, both forced and in their natural season.

In the early part of April, moths appear, spiders abound, the trout rises, frogs spawn, tadpoles appear, the viper is occasionally seen, the mistletoe-thrush

pairs, and the stone-curlew and the pheasant utter their peculiar cry; in the middle part of the month, various well-known insects appear, the crested wren sings, and the hen, the duck, the pigeon, the raven, and the blackbird sit; and in the latter part of the month, the common snake is sometimes seen, the house-martin appears, the blackcap whistles, and the bittern utters its characteristic cry. But by far the most interesting feathered visitors of the month, though some of them are not seen or heard till towards the end of it, are the swallow, the wryneck, the whitethroat, the yellow wren, the willow wren, the grasshopper lark, the ring-ousel, the redstart, the swallow, the nightingale, and the cuckoo.

The Farm.—April, on account of its intervening between the extinction of turnips and the availability of the pasture grasses, is the most difficult month in the year for the maintaining of live-stock, and puts good husbandry and the general economics of the farm very stringently to the test. Irrigated meadows, when tolerably well managed, are a chief good resource; the sowing of grass lands with early grasses is another; the "rouen" method noticed in our article on AFTERGRASS, is, in certain though limited circumstances, a third; and a careful keeping and prolonged use of hay, turnips, carrots, parsnips, and potatoes are a fourth. But some other methods, such as turning stock upon crops of wheat to feed them off, or allowing them to roam over pastures and clover fields, are miserably uneconomical, and occasion a very great eventual loss. Ewes and their lambs must be continued, from last month, wholly on grass. If a farm have a good breadth of irrigated meadow, the whole sheep stock may be fed entirely upon it throughout April; but if otherwise, all other sheep than ewes and their lambs must have a reserve of turnips to maintain them till the middle of the month, and may then be turned upon the pastures. Fat sheep and oxen may be freely sold for the shambles in the latter part of the month; for they usually bring a fully higher price at this time than at any other period in the year. Oxen which are worked in teams should be well fed with good hay, cut straw, and a daily allowance of roots. Horses require to be constantly at full work, and should be abundantly fed with hay, corn, and carrots. Mares often foal in April, and require somewhat nice attention. Colts of three years of age may either be now taken up and trained for work, or be allowed another summer's grass, and taken up for training in autumn. Sows, pigs, and lean hogs, should be kept close within the farm-yards, and supplied with chaff, straw, carrots, parsnips, and potatoes. The young broods of poultry, particularly those of turkeys, now require great attention; and ought either to be so few as to be brought up on the common barn-door system, or so many as to engross the whole care and occupy the whole time of a poultry maid.

Barleys not sown in March ought to be sown at latest by the middle of April. Pease ought all to have been sown before this month; yet they may still be sown with the expectation of a full crop, but not with the certainty of being sufficiently forward to permit a succeeding crop of good turnips. Whenever, as in the old Hertfordshire method, barley is sown before white oats, the latter require to be sown in April. An acre or half an acre of lettuce may be drilled in April for a large stock of hogs. When a succession of tares is part of the economy of a farm two sowings should be made in April, the one at the beginning of the month, and the other towards the end. Thorough tilth, in preparation for madder, should be effected in the beginning of the month; and the finishing tilth, and the planting of the crop itself, should be effected towards the end. April is the time for the sowing of teasel, the sowing of lucerne, and the sowing of burnet; and it is also not

unsuitable for the sowing of sainfoin and of chicory. In the early and middle parts of the month, thorough tillage should be given in preparation for potatoes; and toward the end of the month, or as the last of the great spring operations of sowing and planting, the potatoes should be planted. April is the proper time for the planting of autumnal sown cabbages, for the drill-sowing of cabbages in the situations in which they are to remain, and for the spring sowing of grass seeds; and it is also not unsuitable for the sowing of flax.

The labours of the barn, for the supply of the market and the farm-yard, require still to be continued. Land intended for buckwheat in May or June should now be well ploughed and harrowed. Land intended for turnips should, in this month, first be scuffled, next be allowed a little rest, and next receive sufficient harrowings to make all the seeds of weeds grow, in order that the plants of them may be destroyed by next month's tillage. All work in woods should now be over, and all hedge-work brought to a close. Grass lands which were stone-picked in last month, should now be rolled, to make them level for the scythe. Any mason-work which a farmer may require to perform on his own account, should be commenced in April.

The Kitchen Garden.—The produce of the natural ground of the kitchen garden available for April is very nearly the same as that for March; and the forced produce consists principally of potatoes, kidney-beans, rhubarb, carrots, asparagus, sea-kale, mushrooms, purslane, lettuces, and cucumbers.—In April, sow, in the open ground, kidney-beans, turnips, rhubarb, American cress, curled borecole, cabbages, savoy, broccoli, onions, carrots, parsnips, skerret, salsafy, scorzonera, angelica, lovage, clary, caraway, scurvy-grass; sow, if omitted in March, or if more be wanted, hyssop, marjoram, thyme, savory, bugloss, borage, marigold, dill, fennel, sorrel, burnet, and other similar plants; make successional sowings of cresses, mustard, radish, rape, lettuce, spinach, beet, beans, and pease; sow on slight hotbeds, capsicum, love-apple, basil, purslane, gourds, pumpkins, melons, and cucumbers; make some hotbeds for raising a last succession of melons and cucumbers, and others for planting out previous sowings under bell or hand glasses; maintain a proper and regular heat in the beds of advancing melons and cucumbers; transplant Cos and Silesia lettuces, cabbages, savoy, borecoles, celery, and chamomile; plant sea-kale, balm, chamomile, pennyroyal, mint, tarragon, tansy, chives, burnet, marjoram, and potatoes; earth up early cauliflowers growing under hand glasses; dress and plant artichokes; destroy weeds; and sweep away earthworms, slugs, and snails either by sprinklings with lime-water, or by abandoning the garden once or twice a-week to a flock of hungry ducks.

The Fruit Garden.—The home-grown fruit available for use in April comprises three or four preserved kinds from last year, green gooseberries, and some others for tarts, and dessert strawberries from hotbeds.—In April, destroy insects on fruit-trees; commence the summer-dressing of vines; protect the blossoms of choice peaches, apricots, and nectarines, from frost and heavy rain; remove supernumerary buds from wall and espalier fruit-trees; cut away dead wood and damaged shoots from apple-trees and pear-trees; thin out supernumerary or crowded developments of the young fruit of apricots, and use the thinnings for tarts; examine grafts, give new clay where the old is cracked, and remove all shoots which are produced below the grafts; examine trees which were budded last summer, pinch off all curled leaves from their shoots, and remove all shoots which are produced on their stock; thoroughly weed strawberry beds, and clear away all runners except such

early ones as may be wanted for forming new strawberry plantations in June; and continue the forcing of early fruit on hot walls.

The Flower Garden.—In the beginning of April, Dahlia tubers, if previously unattended to, may be planted either in a mild hotbed or in the barkbed of a bothouse; and during the progress of the month, shoots, as they rise from the tubers, should be slipped off, planted in small pots, and plunged in hotbeds. In the early part of the month, the seeds of tender annuals, such as cockscombs, globe-amaranths, balsams, ice-plants, egg-plants, marvel-of-Peru, stramonium, sensitive-plant, and others, may be sown on a hotbed; the seedlings of tender annuals sown in February and March should be transplanted into hotbeds under frames and glasses; and the seedlings of half-tender annuals should be transplanted to mild botheds, or, in some instances, to warm situations on the open border. Mignonette, ten-weeks' stock, love-lies-bleeding, and prince's feather, may now, in a somewhat dry state of the soil and in genial weather, be sown in the open ground; and almost all kinds of hardy annuals may be sown, either once for all, or in successions. Special care should be exercised over potted carnations, and over beds of choice hyacinths, ranunculuses, anemones, and tulips. Sowings may now be made of carnations, polyanthuses, and almost all hardy biennials and perennials. Carnations from layers may still—at least in the earlier parts of the month—be transplanted. Most kinds of biennials and fibrous-rooted perennials may still be planted, and, with few exceptions, may be propagated by division of the root-clods or of the roots themselves, or, in multitudes of instances, by mere slips or offsets. Many flowering shrubs, if the weather of the early part of the month should be showery and cloudy, may, in that part of the month, be safely transplanted. Edgings may still be formed; but, should the weather be clear and warm, plentiful water must be given. Such flowering plants as require it should be trimmed and supported; the borders should be kept clean from weeds; lawns and grass walks should be kept in perfect order; and gravel walks, if not thoroughly upturned and cleaned in March, should now be broken up and rendered both pleasant to the eye and free from all harbourage for weeds.

MAY.

Phenomena.—May has sometimes been designated the most cheering month in the year; but, in general, it maintains this character only during its latter half; and, though sometimes all pleasant, it is likewise sometimes all chilly. Easterly and north-easterly winds, of a cold, piercing, and sometimes foggy nature, usually prevail throughout its first half, and occasionally prevail till its end; and they frequently intermit so as to allow a short, warm, summer breeze from some other point, and then suddenly return, so as almost to produce a practical transition from summer heat to autumnal cold. But when winter disappears from the north-west of continental Europe, these dismal winds either speedily cease to blow upon us, or become very nearly as warm and pleasant as winds from the south or the west. Most of the western side of Great Britain, however, especially the immediate western seaboard, is much less subject to the vicissitudes of temperature from the easterly winds than the eastern side. The thermometer, on the average of many years, has a mean height in May of about 53°; but it has been known to fall so low as 25° in the night, and to rise so high as 86° in the day. The barometer has a mean height of 29.80, and a mean range of 1.02. The mean fall of rain is not quite two inches; and the actual fall is very different in different years. The mean evaporation throughout the month is at least 3½ inches; and the actual evapora-

tion, during a single day of brisk east wind and clear sunshine, is sometimes considerably upwards of one-third of an inch.

In the early part of May, the common barberry, the horse-chestnut, the common hawthorn, the common maple, the sweet chestnut, the oak, the ash, the tulip-tree, the water-violet, the lily of the valley, and numerous other conspicuous or well-known plants come into flower; in the middle part of the month, the lime-tree, the forget-me-not, the water scorpion grass, the deadly nightshade, and numerous American flowering shrubs, and other conspicuous or well-known plants are in flower; and in the latter part of the month, the mulberry begins to expand its buds, the oak, the ash, the beech, and numerous other forest trees are in leaf, and columbine, lysimachia, the bramble, some roses, and numerous other plants are in flower. The face of every landscape daily improves, throughout May, in interest and beauty. The fields, the woods, the orchards, the gardens, daily increase their attractions, and afford incentives to gratitude and admiration. Some of the most conspicuous flowers of the month are, in the shrubbery, azaleas, rhododendrons, kalmias, lilac, roses, snowdrop-tree, Guelder-rose, barberries, double-flowering cherry, honeysuckle, crataegus, almond-tree, Judas-tree, jasmine, laburnum, and elder; in the parterre, ranunculuses, anemones, irises, rockets, canterbury-bells, jonquils, narcissuses, polyanthus-narcissus, lilies, American cowslip, fox-glove, feverfew, lychnis, honesty, catchfly, candy-tuft, columbines, gentianella, poppies, saxifrages, sweet pease, tulips, monkshoods, spiderwort, fraxinella, ornithogalums, pæonies, pinks, and lily of the valley; and, in the greenhouse, carnations, geraniums, roses, cinerarias, cactuses, fuschias, calceolarias, azaleas, and a profusion of others.

In the early part of May, the stinging-fly and several butterflies appear, the gudgeon spawns, the swift, the redstart, and the white throat appear, the titlark sings, and the cuckoo is often and loudly heard; in the middle part of the month, black snails are very numerous, the common flesh-fly, the blue flesh-fly, the lady-cow, the grasshopper lark, and the large bat appear, and the turtle-dove is heard; and in the latter part of the month, the goatsucker returns, the glow-worm shines, and the dragon-fly and the great white cabbage butterfly appear. Toward the end of the month, and sometimes even in its earlier parts, the air has a freshness, a softness, and a fragrance which exhilarate the spirits and improve the health; and animated nature displays a multitudinousness, a sprightliness, an unceasing activity, and a joyous gladness which evoke and sustain the most pleasurable emotions.

The Farm.—Ewes and their lambs continue on the pastures. Other sheep should have turnips or other spring food till about the 10th or the 12th, and may then be turned into the grass-fields. The folding system, where still practised, is now commenced. Fat sheep, if generally ready for the operation, may, towards the end of the month, be washed and shorn; or they may be suffered to continue as they are till June. Cows ought, throughout the month, to be abundantly and nutritiously fed on rich pasture, in order that both calves and dairy may yield due remuneration. Toward the end of the month, all the older cows in season should receive the bull, in order that they may calve in February. Any two-year old heifers which are designed to be breeders should be separated from the steers of the same age, and herded with the cows; and when they come into season, in this month or afterwards, they should receive the bull. Yearling steers and two-year-old steers ought, about the 10th or 15th of the month, to be turned out to grass. Three-year-old oxen may be fed in the yards as long as turnips

and other spring food last, and may then be sold; and oxen which work in teams may be soiled on lucerne as horses, and will thrive better on it, and cost less than if they were pastured. When the east winds cease to blow or to be cold, sucking calves may be turned into a small paddock; and when they have become weaned, they may be herded with the cows and the rest of the feeding-stock. At the beginning of the month, horses should cease to have dry hay, and commence to be soiled in the stable on lucerne or on tares or clover; or where this is impracticable, they must continue to receive a full allowance of hay and corn. Colts should be turned out, for the season, to grass. Breeding mares should receive the male, in order that they may foal in April. When the farm-yards are cleared of cattle, all the hogs should be sorted, and such as are of proper age for feeding on clover or otherwise in the fields, may be separated from the rest and turned adrift; yet, though the cost of feeding may be greater, they will probably yield a better return by being soiled in the yards. Bees may now be expected to swarm, and ought to be well watched. "About the twelfth of May," says Arthur Young, "the farmer may calculate that he will have a sufficient bite of grasses to leave off foddering entirely; and before that, he should not think of it; for if cattle are turned into grass not sufficiently advanced in growth, they will require such a number of acres, that his mowing-ground will be greatly curtailed. As soon as the yards are cleared, if he is in the mixing system, the dung in them must be turned over, and mixed carefully with the stuff beneath, whether it be chalk, marl, turf, ditch-earth, or whatever sort." See the article FARM-YARD MANURE.

Lucerne may still be sown in the early part of the month; hemp must be sown about the middle; and buckwheat may be sown toward the end. Sainfoin, if the soil be proper, may be sown with buckwheat. Potatoes may be planted in any part of the month; and the drill-sowing of cabbage, in the situation in which they are to remain, may be done at the beginning. Swedish turnip should be sown in the latter part or toward the end of the month; and flax may be sown in the early part or toward the middle. If a succession of tares be depended on for soiling, one crop must be sown in May. If the sowing of barley with grass seeds have been neglected in April, and be regarded as very desirable, it may still, in the sluggard's fashion, be performed in the beginning of May.

The operations of the barn are but partial in the early part of this month; and they nearly cease toward its middle. Except, indeed, for a reserve of summer litter and of sufficient straw for thatching the earliest stacks in autumn, the barn-yard ought, for the season, to be swept clean at the transferring of live stock from the farm-yards to the fields. The preparation of the land for turnips is a main part of the business of May, and extends through all the month, and sometimes a little into June; and it ought to be performed in the order in which the different kinds of turnips are sown,—beginning with the land for Swedish turnips, which are to be sown before the close of this month,—and proceeding successively with that for yellow turnips, and with that for white turnips, both of which are to be sown in June. The carrot crop, if not hand-hoed in April, must be hand-hoed in May. The crops of early potatoes and the April-planted crops of cabbages, madder, and liquorice, must also be now hand-hoed. If any land be laid out for bare summer fallow, it ought now to receive a turning and cleaning. Fields of wheat, barley, oats, beans, and pease, ought now to be thoroughly cleaned, whether by horse, by hand, or by both. The busy period of the household dairy begins in May, and will continue till the end of October. The paring and

burning of turf-land may still be practised at any time till the end of May. Old plantations of hops must now be poled; and new plantations cleaned, and earthed up. The formation of irrigated meadows may be successfully achieved in any time of the year except during severe frosts; but it is done most economically, and with least risk of failure or disappointment, in the month of May. Very forward tares, or well manured lucerne, may, after a mild spring, yield a mowing toward the end of this month. The balancing of the yearly accounts of the farm is done with most convenience and suitableness in May.

The Kitchen Garden.—The produce of the natural ground of the kitchen garden available in May comprises cabbages, cabbage-sprouts, borecoles, broccoli, cauliflower, cress, water-cress, turnips, turnip-tops, chervil, corn-salad, beet, carrots, parsnips, beans, pease, garlic, onions, leeks, chives, eschalots, balm, borage, sea-kale, asparagus, tansy, thyme, fennel, endive, burnet, horse-radish, marjoram, lettuces, Jerusalem artichokes, potatoes, spinach, sage, sorrel, mustard, mint, rocambole, radishes, and parsley; and that of hotbeds and other forcing appliances comprises pease, potatoes, carrots, melons, cucumbers, lettuces, kidney-beans, purslane, and mushrooms.

In May, sow lettuce, cresses, mustard, radishes, rape, spinach, turnips, carrots, cauliflower, broccoli, borecoles, savoys, cabbages, beans, pease, endive, parsley, and celery; plant out from the hotbeds to the open ground vegetable marrow, pumpkins, gourds, kidney-beans, capsicums, love-apples, and lettuces; transplant cabbages, savoys, borecoles, celeriac, celery, and cauliflower; cut shoots of asparagus for the table; tie up early lettuce; thin and clean carrots, parsnips, onions, turnips, skirret, salsify, scorzonera, large-rooted parsley, and cardoons; stick pease; propagate lavender and other perennials by slips and cuttings; support the stems of such plants as are intended to run to seed; water newly planted crops; continue a watchful care over growing melons and cucumbers; plant out melons and cucumbers under hand or bell glasses; and sow, either on a hotbed or in a warm part of the open ground, cucumbers intended for pickling.

The Fruit Garden.—The home-grown fruits available for use in May are apples, pears, walnuts, and almonds from last year; gooseberries and currants from the open ground; and apricots, nectarines, cherries, figs, melons, grapes, peaches, and strawberries, from hot-walls, hotbeds, and hothouses. In May, clear away from fruit-trees all such new shoots as are ill-situated or useless; train good shoots of fruit-trees on walls and espaliers; break off the points of the young shoots of fig-trees; thin such fruit of apricots, peaches, and nectarines as appears too thickly set; prune all redundant shoots, thin out the crowded fruit, and handpick the caterpillars, of gooseberry bushes; destroy snails from apricot-trees, peach-trees, and nectarine-trees; destroy by fumigation or otherwise the aphides on fruit-trees; destroy, by caustic sprinklings or by picking, such slugs as can be found about the roots of pease, the base of walls, or in any other situation; water recently planted fruit-trees; clear away all useless shoots from vines; profusely water blooming-strawberry plantations twice or thrice a-week; and remove all shoots from the lower parts of grafted stocks, and from stocks of last year's budding.

The Flower Garden.—In May, continue to shade and shelter choice beds of tulips, anemones, and ranunculuses; take up the bulbs of hyacinths which have ceased to flower, and have become embrowned in the upper part of the leaves; remove the seed-vessels from such tulips as have dropped their petals; take up the bulbs of crocuses, crown-imperials, and other early flowering bulbous plants which have begun to

decay in their leaves; transplant, toward the end of the month, autumnal crocus, autumnal narcissus, colchicums, and other autumnally flowering bulbs; stick and dress carnations; transplant into the open ground, or plunge in pots into the open border, half-tender annuals; prick out, and transplant into a hotbed, cockscombs, balsams, and other tender annuals sown in April; sow, in the early part of the month, a succession of balsams and other tender annuals on hotbeds, and of mignonette, china-aster, Indian pink, ten-weeks'-stock, candytuft, Lobel's catchfly, clarkia pulchella, African marigold, French marigold, and some other hardy annuals, in the open ground; dress and remove to the open air such auriculas as flowered in pots upon stages; propagate hardy, perennial, fibrous-rooted plants by cuttings; propagate double-wallflowers, and double rockets, by slips of the terminal young shoots; plant tuberoses for autumnal bloom; transplant seedling biennials and herbaceous perennials; sow stocks, wallflowers, carnations, columbines, pinks, sweetwilliams, hollyhocks, Canterbury bells, French honeysuckles, and other biennials and perennials; support all drooping and climbing flowering plants; and maintain the walks, flower-borders, and entire garden in perfect order.

JUNE.

Phenomena.—June competes with August the character of being the most pleasant month in the year. In rare instances, most of June is cloudy and comparatively cold; and in a few, the early part of it, even though preceded by a warm May, is ungenial; but, in greatly the majority, some period of it between the 6th and the 18th days, is the commencement of the fervid heat of summer. The temperature has never been known, in the vicinity of London, to fall lower at night than 37°; and it has repeatedly been observed to rise in the shade by day to 90°. The thermometer usually ranges between 40° and 60° by night, and between 58° and 78° by day; and it has a mean height, in the average of many years, of about 50°. The mean height of the barometer is 29.90. The prevailing wind is from the south-west; and if it have been dry and northerly during May, it now not unfrequently brings heavy showers. The average depth of rain is about the same as in May; and the average evaporation, in consequence of the superior heat and the great length of the day, is not less than about four inches.

In the early part of June, wheat is in the ear; the broom, the nettle, the Scotch rose, the water-lily, the round-leaved mallow, and numerous other plants are in flower; in the middle part, many of the pasture-grasses bloom, and the bulbous irises, the hardy ixias, the Byzantine gladiolus, and numerous other plants of the parterre come into flower; and in the latter part, oats and barley are in flower, the bottle-flower and numerous other plants come into bloom, the shoots of ligneous plants are quite or nearly at their full height, strawberries are abundant, and some varieties of red and black currants are ripe. Among the multitudes of conspicuous flowers which lend their beauty and magnificence to June, some of the best known are, in the shrubbery, magnolias, azaleas, Guelder-rose, jasmine, roses, rose-acacia, lilacs, leriodendron, snowdrop-tree, sage-tree, lavender, kalmias, honeysuckle, horse-chestnut, and scarlet maple; and, in the parterre, fritillaries, saxifrages, calceolarias, Byzantine gladiolus, feverfew, convolvulus, stocks, amaranth, globe-flower, lilies, martagons, carnations, larkspurs, scarlet lychnis, tulips, sweetwilliams, pinks, ranunculuses, poppies, gnaphalium, fraxinella, foxglove, campanulas, bear's-breach, irises, honesty, mallow, spiderwort, American cowslip, golden-rod, scabious, snapdragon, orchises, lupines, nasturtium, peonies, sweet pease, and a great multitude of others.

In the early part of June, the wasp and several species of butterfly appear, the fly-catcher and sedge-sparrow are seen, and a considerable proportion of bees swarm; in the middle parts of the month, more bees swarm, and the forest-fly, the burnet-moth, and numerous other flies and moths, as well as beetles and butterflies, appear; and in the latter part of the month, dragon-flies appear, insects are exceedingly numerous, and a considerable proportion of singing-birds drop into silence and retire to the woods. "The melody of the feathered songsters may be still heard, but it will soon cease. A few solitary birds only will sing among the verdant branches, or warble through the fervid atmosphere. The music of birds was the first song of thanksgiving which was offered on earth before man was 'formed;' and it continues to charm the ear and delight the soul of man, though he is fallen and degraded. Old Isaac Walton observes, with equal truth and beauty, 'He that at midnight, when the weary labourer sleeps securely, should hear, as I have often done, the clear airs, the sweet descants, the natural rising and falling, the doubling and redoubling of the nightingale's voice, might well be lifted above earth, and say,—Lord, what music hast thou provided for the saints in heaven, when thou affordest bad men such music upon earth.'"

The Farm.—Throughout June, all kinds of sheep are depastured within enclosed fields or on sheep-walks, and, as regards their mere feeding, are very easily managed. But about the beginning of the month, they must be washed; about eight days after, they must be shorn; and, in every part of the month, they must be watched and protected against the attacks of the fly. All sheep within enclosures, and especially in woodland districts, ought to be examined every day, lest they be fly-struck; for if such as are struck be not speedily dealt with, they may, in twenty-four hours, be past cure. June is an excellent period for sheep-folding, with those who still practise it. Sheep-stock intended for fattening, such, for example, as wethers bought in April or May, and designed to be sold fat from turnips or cabbages in the following winter, ought at present to be well kept. Throughout June, all cows and steers may be kept entirely upon pastures; or they may, to any degree a farmer chooses, be soiled. Even the latest calves should now be weaned, and turned out to graze. All cows and heifers, and also all mares, intended to breed, and hitherto neglected, ought now to be brought to the male. In the early part of the month, horses should continue to receive green food; and towards the middle of it, they may be left, throughout the night, in a pasture field.

The thorough and completing tillage of the land for turnips ought, with all speed and care, to be performed; and yellow and white turnips—and previously Swedish turnips, if not sown in the latter part of last month—must now be sown. Turnip crops sown later than June, even in the most genial districts of England, seldom attain full size; and multitudes of experienced farmers have a notion that the turnip season lasts exactly a month, and is very nearly coextensive with June. When Swedish turnips have been sown in May, a second or even a third sowing may, if the farmer chooses, be made in June. Cabbages may now be planted in drills, either on land prepared for themselves, or in fields or parts of fields, on which the sowings of Swedish turnips fail; cabbages planted in April, and hand-hoed or horse-hoed in May, should now receive another hoeing; and cabbages drill-sown in April, in situations whence they are not to be transplanted, ought, in June, to be carefully thinned to proper distances, and the tops of their ridges well hand-hoed, and the intervals skimmed, that they may be gradually reduced to a state of fine pulverization. Potatoes ought, in this

month, to receive so thorough a hoeing as not to need another. Madder must receive a cautious hoeing in some part of the month; and carrots may require one toward the end. Lucerne must be attended to; flax must be weeded; liquorice must be hoed; and hops must be operosely cultivated. Toward the end of the month, sainfoin, clover, irrigated meadows, and some rich dry meadows, may be ready for mowing. At the precise time in the month, when the plants are just ceasing to bloom, buck-wheat, vetches, or other similar green crop grown for green manure, ought to be ploughed in. During the month, drilled crops of beans and pease ought to receive at least one hoeing; bare fallows, whether for wheat or for barley, ought to undergo a stirring; flax-crops should be cautiously hand-weeded; all crops of corn, when necessary, ought to be hand-weeded; and all hedges, field-borders, road-sides, and other harbourages for seeding weeds, ought to be swept of their rank vegetation. Rape or cole, when intended for sheep feed, may be sown at any time in either June or July. Many operations of an improving, a general, or a miscellaneous kind, may most advantageously be performed in June,—particularly the digging of marl, clay, and chalk, the emptying of ponds, the cleansing of streams, paring and burning, the planting of holly hedges, the warping of low alluvial grounds, the burning, carting, and spreading of lime, the burning of dry weeds for manure, and the improving of moors and mountains.

The Kitchen Garden.—The produce of the natural ground of the kitchen garden available for use in June comprises cabbages, cauliflower, turnips, beet, beans, pease, carrots, radishes, artichokes, lettuces, leeks, onions, chives, cress, water-cress, eschalots, asparagus, thyme, balm, tansy, celery, chervil, mustard, mint, burnet, basil, marjoram, parsley, sorrel, purslane, spinach, borage, fennel, horse-radish, marigold, and savory; and that of hotbeds and other forcing appliances consists principally of melons, cucumbers, kidney-beans, and mushrooms.—In June sow radishes, mustard, cresses, rape, turnips, kidney-beans, pease, beans, cabbages, borecoles, spinach, and cucumbers; thin and weed turnips, carrots, beet, parsnips, onions, borecoles, salsafy, skirret, parsley, and scorzonera; transplant lettuces, cauliflowers, broccoli, leeks, savoys, cabbages, borecoles, hyssop, savory, marjoram, thyme, basil, cardoons, love-apples, capsicums, and pickling cucumbers; transplant for blanching celery and endive; select fine early, large-headed cauliflower plants for running to seed; gather shoots of asparagus, flowers of chamomile, and plants of balm, mint, and other aromatic herbs; give full scope to melons growing under bell-glasses, and occasionally shade melons growing in frames.

The Fruit Garden.—The home-grown fruit available for use in June comprises, in various conditions, walnuts, almonds, apples, pears, cherries, strawberries, gooseberries, currants, apricots, peaches and nectarines,—most either from last year for baking, or young and green of the present year for tarts.—In June complete the dressing of peach-trees, apricot-trees, and nectarine-trees; thin wall-fruit, and apply the thinnings to tarts; regulate the strong shoots of pear-trees, plum-trees, apple-trees, and other fruit-trees on walls and espaliers; render secure any recently planted standard fruit-trees which appear to have loose hold of the soil; reduce to order the straggling and matting growths of vines on walls; water blossoming and fructifying strawberry plantations, and remove to a nursery bed a good stock of young strawberry plants for intended new plantations; protect cherries from birds; begin to propagate peaches, apricots, and nectarines by budding; support the most vigorous growths of last year's buddings, destroy snails, grubs, and caterpillars,

fumigate aphides, and syringe, wash, or smear peach and nectarine trees attacked by minute fungi.

The Flower Garden.—In June, most hardy annuals should be thinned, and many may be transplanted; all the half-tender annuals, and some of the more tender ones, may be removed into beds, borders, or other parts of the open ground; very tender annuals, designed to occupy the stages of the greenhouse while the perennials are turned into the open air, should be watered and otherwise attended to; some kinds of hardy annuals, such as mignonette, ten-weeks'-stock, candytuft, nemophila, gilia, and clarkia, may still be sown; the bulbs of such tulips, crown-imperials, anemones, and other bulbous and tuberous-rooted plants as are decaying in the leaf, should be taken up, and their offsets separated; autumnal flowering bulbous-rooted plants may be transplanted; perennial fibrous-rooted plants, such as double rockets and double scarlet lychnis, may be propagated from cuttings of the flower-stalks; the seedlings of biennials and perennials should be transplanted; dabbias should be staked, and drooping herbaceous plants supported; carnations, pinks, mule-pinks, and double sweetwilliams should be layered or piped; box-edgings should be cut, all flowering plants which are in any degree succulent should be watered; caterpillars and other insects should be sought out and destroyed; lawns and grass walks should be mown; and borders, beds, gravel walks, and all other parts of the garden ought to be kept quite free from weeds and in the neatest and most orderly condition.

JULY.

Phenomena.—July is well known to be, on the average, the hottest month in the year. Summer, in all its fervour, brilliance, and occasional sultriness, is now triumphant.—In some years, nearly all July is thundery and sultry; in others, especially when south-west winds blow without intermission, much of it is very wet; and in a few, it has an average cold as great as generally prevails in September or the first half of May; but in the majority, it is clear, hot, brilliant, and comparatively dry. The thermometer usually ranges between 48° and 62° by night, and between 64° and 84° by day; and it has a mean height on the average of many years, of about 63°; but it has sometimes stood, for several successive days, at or near 85°, and has been known to rise so high as 99°. The barometer ranges 0·81, and has a mean height of 29·88. The prevailing winds are from the south-west, with intermissions from the south-east. The mean fall of rain is about 2½ inches; and the mean evaporation is nearly four inches.

In the early part of July, pinks and carnations are in their glory, lavender is in flower, and puff-balls and tremella nostoc appear; in the middle part of the month, lilies are in their glory, potatoes are in flower, asparagus is in fruit, and gooseberries and raspberries are ripe; and in the latter part of the month, devil's bit, burnet, saxifrage, nightshade, and a profusion of other plants are in flower. Among the multitude and almost myriads of flowers which render July the grand season of floral triumph, a few of the most conspicuous, are, in the shrubbery, cistuses, itea, fuschias, roses, rose-acacia, leriodendron, brooms, buttonwood, honeysuckle, jasmine, rosemary, and bramble; and in the parterre, campanulas, rockets, saxifrages, stocks, scarlet lychnis, veronicas, lupines, pinks, lavateras, carnations, candytuft, sweet-pease, sweet-sultan, ornithogalums, pansies, nasturtiums, marvel of Peru, African marigold, larkspurs, irises, scarlet-runners, columbines, cockscombs, globe-flowers, French marigold, golden-rod, catchfly, honesty, balsams, amaranths, calceolarias, cinerarias, petunias, salvias, gladioli, feverfew, lobelias, clarkias, Chinese

pinks, columbines, pentstemons, hollyhock, spider-wort, sweetwilliam, and sunflowers.

In the early part of July, the stone curlew sometimes whistles, the golden-crested wren sometimes chirps, and the cuckoo ceases to sing; in the middle part of the month, frogs migrate, hens moult, the frog-hopper abounds, and the quail is heard; and in the latter part of the month, partridges fly, the great horsefly appears, and swallows are untiringly on the wing in pursuit of flies and other insects. During the hotter portion of many of the days, the greater part of animated nature sinks into lassitude, retreats into shelter, or drops into repose; birds languish, and secrete themselves in the woods; sheep court the shade and coolness of lofty enclosures; horses crowd beneath the shade of umbrageous trees; cows stand ruminating in the cool pond; swine revel in the mire; and insects alone seem to retain their activity, and to find mirth and buoyancy in the fiery sunbeams.

The Farm.—All cows, oxen, and weaned calves may be kept wholly at grass throughout July; or if a proper succession of soiling crops have been provided, any reasonable number of beasts may, during every day of the month, receive abundance of food in the yard or the stall. Beasts in the field ought to be daily, however generally, inspected; and as high fed ones are apt to break bounds, the fences ought to be maintained in perfectly good condition. All sheep, during July, ought to have access to shade and pure water; and ewes intended for breeders ought to be well kept, in order that they may be in a healthy and strong state for the ram in August. Horses should continue to receive a portion of green food during each day, and may be allowed to remain in pasture fields during the whole of each night; and as their labour will be diminished towards the middle of the month, they may then begin to receive a diminished allowance of corn. Weaned pigs and sows that have pigs may now receive such lettuces as were early sown on rich warm land; or the whole stock of swine may be fed on clover, chicory, lucerne, or garden beans. Dairy wash may now accumulate in the cisterns for sows and weaned pigs, for a time when they shall have more need of it than at present. Sows ought to be kept away from the boar from the beginning of July till the middle of November, in order that they may not farrow in winter.

In the course of July, the turnip and the potato crops must again be hoed; and toward the end of the month, they may be set up by the double mould-board plough. In any part of the month, cole-seed may be sown upon land prepared in the same manner as for turnips; and in cases in which a second sowing of turnips may have failed, cole-seed may, toward the end of the month, be sown as a substitute. Cabbages planted in April or May, and horse-hoed in June, may possibly not need further attention till August, yet, when necessary, ought now to receive attention and labour. Weld must be pulled. Crops of carrots and parsnips must be hoed. Crops of beans are now so high that, when hoeing is necessary, they must receive it with caution. Lucerne may again be cut; and if it was drilled for horse-hoeing, the intervals must be directly horse-hoed the contrary way to the last. Crops of burnet left for seed are now fit for mowing; and, in order to prevent the shedding of the seed, they must be mown with great care. All meadows and pastures, not mown in June, should now be cut. Bare fallows ought to be duly and sedulously worked, and not, by any means, neglected for the sake of haymaking and of preparations for harvest. The carting of marl, chalk, clay, and mud may still proceed. Madder planted late in May or early in June must now be hoed. Forward white pease are ready to be cut in the former part of the month; some barley may probably be ready toward the end of the month;

and some wheat, when the practice is adopted of cutting it ten days before it is ripe, may also be ready. Any crop of wheat which shows symptoms of being attacked by mildew must, with all expedition, be cut. Buckwheat, when sown so very late as the first week of July, sometimes succeeds well, and yields a large crop. Paring and burning may still proceed. The work of warping ought to make progress with every tide.

The Kitchen Garden.—The produce of the kitchen garden available for use in July comprises potatoes, turnips, beet, ca rots, beans, pease, artichokes, garlic, onions, leeks, eschalots, rocambole, cabbages, cauliflowers, angelica, balm, spinach, horse-radish, kidney-beans, basil, borage, thyme, sorrel, burnet, chives, chervil, savory, tansy, cucumbers, melons, cresses, endive, sage, rosemary, fennel, marjoram, mint, marigold, mustard, purslane, mushrooms, radishes, and parsley.—In July, sow broccoli, endive, kidney-beans, rape, mustard, radishes, cresses, onions, carrots, turnips, lettuces, borecoles, cabbages, pease, and beans; gather seeds of all sorts of garden plants as they ripen; transplant cabbages, savoy, borecoles, broccoli, endive, cauliflowers, leeks, celery, and lettuces; hoe advancing crops of cauliflowers, and shade with their own leaves large heads of nearly matured crops; earth up the crops of celery which were planted in May and June; pull full-grown garlic, onions, eschalots, and rocambole; prune crowded melons, and plant cuttings of them for a succession crop; protect melons from heavy rain, and shade or fumigate such as are attacked by the red spider; give copious daily waterings to cucumbers; remove from the lower part of the stems the smallish heads of artichokes and cardoons, so as to promote the full development of the larger heads; gather sage-tops, lavender-spikes, chamomile flowers, and plants of pennyroyal, hyssop, mint, balm, marjoram, and other aromatic herbs, and place them to dry for winter's use; plant, early in the month, slips of sage, hyssop, rue, lavender, savory, and other perennial herbs; water, during dry weather, all such plants as have been recently transplanted, and clear away all leaves and stems of plants which have ceased to bear.

The Fruit Garden.—The home-grown fruits available for use in July are walnuts, almonds, apples, pears, gooseberries, currants, cherries, figs, grapes, apricots, peaches, nectarines, plums, and strawberries. In July, prune such wall-trees as have not previously received their summer pruning; bud plants of cherries, plums, apricots, peaches, and nectarines; prune and regulate fig-trees; clear away redundant shoots of vines; destroy snails and wasps on wall-trees; apply the suitable wash to peach-trees, nectarine-trees, and other plants attacked with mildew; and displace shoots from the stocks of trees grafted in the present year or budded in the last.

The Flower Garden.—In July, support and water choice carnations; propagate carnations, pinks, mule pinks, and double sweetwilliams by layering and piping; remove tender annuals from the frames or glass-cases to the greenhouse, the conservatory, or the open border; remove and transplant such young carnations as were layered in June; transplant biennials and fibrous-rooted perennials sown in spring or in the beginning of summer; remove weeds and dead leaves from potted auriculas; transplant seedling primulae; take up such bulbous roots as the decaying state of the leaves indicates to be ripe; propagate various kinds of perennial plants by cuttings; and keep all the implements, appliances, and methods of garden culture and garden cleanliness in full and laborious operation for the maintenance of neatness and perfect order.

AUGUST.

Phenomena.—August is generally the most pleasant month in the year. In some years, it is hotter

than July; and in very rare years, it is either unseasonably cold or exceedingly thundery; but, in the great majority of years, it possesses a maximum of the delights of summer, with a minimum of its disagreeables, or most pleasantly blends the characters of summer with those of autumn. Most of its nights are close and warm; and many of its days have a temperature ranging between 62° and 80°. The thermometer, on the average of many years, has a mean height of 62°; but it has been known to stand, during several successive days, at a height of between 85° and 90°; and it is recorded to have repeatedly risen to 96°. The barometer ranges 1.02 inch; and has a mean height of 29.85 inches. The mean fall of rain is about 1½ inch; and the mean evaporation is 3.8 inches. The winds are similar to those of July.

In the early part of August, some grains have ripened, others are rapidly ripening, and rue, burdock, melilot, and yellow succory are in flower; in the middle parts of the month, meadow-rue, wild clary, ploughman's spikenard, potamogetons, and polygons are in flower; and in the latter part of the month, the earlier kinds of hardy kernel fruits are ripe, and teasel, autumnal crocus, and numerous other plants are in flower. Some of the most conspicuous of the multitudinous garden flowers of August, are, in the shrubbery, cistuses, passion-flowers, spiraeas, trumpet-flower, tamarisk, clematis, leriodendron, broom, rose-acacia, roses, fuschias, jasmines, honeysuckles, and yuccas; and, in the parterre, hollyhocks, mallows, sunflowers, golden-rod, scarlet-runners, amaranths, asters, campanulas, nigella, lupines, cockscombs, columbines, phloxes, petunias, lobelias, verbenas, salvias, African marigolds, French marigolds, dahlias, catchfly, china-aster, candytuft, starwort, sweetwilliam, tricolor, capsicum, balsam, carnations, mesembryanthemums, convolvulus, nasturtium, feverfew, marvel-of-Peru, collinsia, nemophila, Indian pinks, zinnias, sweet pease, lavateras, stocks, and a profusion of other summer and autumn flowers, besides occasional reappearances of wallflowers, primulae, and some other spring flowers.

In the early part of August, bees kill their drones, and flying-ants and the gorgeous swallow-tailed butterfly make their appearance; in the middle parts of the month, several birds resume singing, swallows and young martins begin to congregate, swifts begin to depart, the black-eyed marble butterfly appears, and the burrel-fly lays its eggs on horses; and in the latter part of the month, rooks roost on their nest-trees, and numerous birds, particularly robins, owls, and stone-curlews, utter their peculiar notes or calls. Insects so abound in August as most visibly to people both the air and the waters. The transformations of most insects and of some other animals are now completed. Caterpillars and maggots can no longer be seen; moths and butterflies emulate the birds in at once number, movements, and beauty; the frog has emerged from the tadpole, and leaves its watery home to enjoy its gymnastics upon the land; and the living inmates of many kinds of eggs, from the microscopic to the great in size, have burst from their imprisonment, and luxuriate in the energies and feats of life according to their several organizations and instincts. The owl may now be seen, and more frequently heard, uttering its lugubrious screech; the weak-eyed bat flies with endless evolutions and with short shrill shriek, in pursuit of the moths and other insects which revel in the evening air; the glow-worm occasionally lights up its tiny lamp by the hedge-side; and large black slugs may frequently be seen creeping across the shady paths of lanes and gardens, either luxuriating in the moisture of past showers, or affording a prognostic of showers to come.

The Farm.—Throughout August, cows, steers, calves, and all kinds of sheep may be kept constantly

at grass; and horses may continue to be treated in the same manner as during the latter half of July. Lambs and old ewes designed to be sold should now be separated from the rest of the stock, and may perhaps be advantageously disposed of at some of the nearest August lamb fairs. Breeding ewes which have been well kept and are in good condition should now receive the ram, in order to the producing of early fat lambs. Many sows now produce their second litter of pigs; and both they and the pigs should be fed on such skimmed-milk, buttermilk, and cheese-whey as have been accumulating in the cisterns throughout the preceding months.

The reaping and harvesting of wheat and of other valuable crops is usually so chief and prominent a part of the farm-work of August, as to give a distinctive character to the month, and to impart a pervading feature to the landscapes of all the arable districts of the country. Reapers should have been engaged, the stalk-yard should have been cleared, and all minor preparations should have been made; and the whole work of reaping and harvesting must be carried on with all possible energy and judgment, in adaptation to the ripening of the crops and the vicissitudes of the weather. In the beginning of the month, rape, if intended for a crop to reap, may be sown; about the same time, the second horse-hoeing should be given to the crop of cabbages planted at midsummer; in the course of the month, cabbages and borecoles for transplanting in April must be sown, the broadcast crops of turnips should receive a hand-hoeing, potato crops must, if necessary, receive a hand-hoeing, and another cutting of lucerne should be made; and in the last week of the month, cabbages may be drill-sown in ridges on situations whence they are not to be transplanted. In wet days, when horses cannot be employed in carting home crops, and when all the harvest men are employed in reaping and mowing, or on other leisure or available days of the reaping and harvesting period, bare fallows ought to undergo a continuation of tillage and manurial preparation, and the bottom layer of the farm-yard may be formed, extended, or completed, by the carrying to it of marl, chalk, turf, ditch-scurings, or pond-mud. In August also, such hay as is ready, should be brought home to the farmery and stacked; a portion of stock may be turned into the sainfoin fields which were mown in June; hemp, at thirteen weeks' distance from the time of sowing, should be pulled; flax also must be pulled; and lands intended for pasture—especially such as have strong, wet, or heavy soils—ought to be laid down to grass.

The Kitchen Garden.—The produce of the kitchen garden available for use in August comprises potatoes, turnips, cabbages, savoys, onions, leeks, eschalots, romanesco, artichokes, love-apples, pease, beans, beet, spinach, parsley, radishes, horse-radish, purslane, angelica, water-cresses, balm, borage, endive, cucumbers, melons, mushrooms, fennel, French fennel, garlic, burnet, cauliflower, marjoram, sage, thyme, lavender, carrots, celery, lettuces, chives, mustard, chervil, marigold, mint, rosemary, savory, sorrel, spinach and tansy. In August, sow, in the open ground, cabbages, borecoles, savoys, onions, carrots, radishes, turnips, mustard, rape, cress, angelica, fennel, endive, chervil, and lamb-lettuce; sow, in a hotbed, broccoli and cauliflower; sow, in a warm spot of rich mellow ground, winter spinach; transplant broccoli, savoys, celery, lettuces, endive, and borecoles; weed and thoroughly clean asparagus beds; remove the smaller and lower heads of artichokes; hoe and handweed all crops which require cleaning; earth up the cardoons which were planted in June; take up eschalots and garlic as soon as their leaves begin to decay; gather mint, pennyroyal, and other aromatic herbs for distillation just as they are coming into flower; cut down, shorten, gather,

and otherwise manage perennial-rooted aromatic herbs for family use; gather seeds from all sorts of plants as they ripen; give due attention to melons and cucumbers; and give a fumigation of tobacco to cucumbers in order to destroy the green fly.

The Fruit Garden.—The home-grown fruits available for use in August are apples, pears, plums, cherries, peaches, apricots, nectarines, currants, gooseberries, figs, mulberries, grapes, raspberries, and strawberries.—In August, give another examination and dressing to vines, peach-trees, nectarine-trees, apricot-trees, and other wall-trees; carefully gather wall fruits; clean and reduce to perfect neatness fruit-tree borders; apply a little oil to maturing figs, and give them all possible advantage from the play of sunshine; loosen the bandages from all stocks and trees which were budded in July; and protect wall-fruit from insects and birds.

The Flower Garden.—In August, give very frequent waterings to plants in pots; shift potted auricula plants into fresh compost; lift auricula plants in the open ground, divide their roots, and transplant each piece into newly dug and manured soil; prick out and transplant seedling auriculas and other primulae; remove and transplant layered carnations; thin out and transplant piped carnations and pinks; transplant seedling biennials and perennials; cut box and thrift edgings; trim hawthorn, hornbeam, privet, holly, yew, lime, elm, and beech hedges; gather seeds of all sorts of plants as they ripen; give constant attention to the keeping of lawns, walks, borders, and the whole garden in perfect order; and toward the end of the month, propagate fibrous-rooted perennial plants, by slips and by division of the roots.

SEPTEMBER.

Phenomena.—September is often characterized as the most healthy month in the year. It occasionally has proved the hottest month; it has, in very rare instances, been known to have some frost and even snow; but, in general, it concentrates all the most agreeable properties of the temperate zone. Though the mean temperature is very sensibly fallen from that of July and August, yet the abundant radiation of heat from the soil often renders the prevailing warmth but slightly inferior to that of summer. The thermometer has a mean height of about 58°, and usually ranges between 38° and 58° by night, and between 55° and 76° by day; but it is recorded to have fallen so low as some points beneath 32°, and to have risen so high as 89°. The barometer usually ranges 1.1 inch; and has a mean height of 29.88 inches. Thunder storms occasionally happen, but are usually shorter and less violent than those of July and August. The mean fall of rain, on the average of many years, is 2½ inches; and the mean evaporation is about 2½ inches. The weather, during the whole of the month, is usually settled, fine, and bracing; and though the mornings and evenings are frequently cold and misty, the greater part of the day, in general, has a pleasant degree of heat, and a pure, bright and glowing atmosphere.

The woods, the hedges, and the orchards now exhibit their various and exuberant productions, and challenge the admiration of observers, the care of cultivators, and the delight of consumers. In the early part of the month, the traveller's joy is in flower, some fungi appear, and the leaves of the sycamore, the elm, the lime-tree, the mountain-ash, and the birch begin to change colour; in the middle part of the month, the furze, the laurel and the ivy are in flower, the catkins of the birch and the hazel are formed, and all gradations of fructification from the blossom to the ripe fruit are simultaneously on the bramble; and in the latter part of the month, hips, haws, and filberts are ripe, and the leaves of the elm, the ash, the plane-tree, the hornbeam, the

cherry-tree, the oak, the sycamore, the willow, the maple, and the hawthorn display their respective autumnal hues, and jointly impart a rich and most varied tinting to woodland scenery. Some of the most conspicuous of the multitudinous flowers of the month are, in the shrubbery, clematis, honeysuckle, passion-flower, pomegranate, spiræas, roses, jasmines, broom, bramble, althæas, fuschias, chaste-tree, and arbutus; and in the parterre, china-aster, Indian pink, convolvulus, dahlia, nasturtium, nigella, poppy, sweet sultan, spiderwort, starwort, catchfly, sunflowers, stocks, amaranths, African marigold, French marigold, colchicum, campanulas, balsams, mesembryanthemums, feverfew, autumnal crocus, golden rod, Guernsey lily, capsicum, candytuft, zinnia, sanvitalia, mignonette, lavatera, hollyhock, larkspur, monkshood, phlox, marvel of Peru, lupines, veronicas, tricolor, scabious, tuberoses, and a profusion of others.

In the early part of September, the bull utters his peculiar autumnal cry, the swallow sings, linnets congregate, and young broods of goldfinches appear; in the middle parts of the month, herrings are caught in vast abundance, the common owls utter their dismal cry, the flycatcher disappears, and the ring-ouzel, the saffron-butterfly, and the red underwing moth appear; and in the latter part of the month, storks congregate, the swallow departs, the fieldfare and the woodcock appear, and the woodlark sings. Swallows, when preparing to depart, assemble in large numbers on lofty buildings; they, for several successive days, spread their wings and make trials of their strength; and, when quite ready, they promptly and simultaneously depart, sailing away to summer regions, and "leaving the green meadows of England for the myrtle and orange groves of Italy, and for the palms of Africa." In the sunny mornings of September, the webs of the geometric spider are hung on almost every bush; and they collect the descending dew into pearly drops on almost every thread, and appear, in the play of the sunshine, like a work of the most exquisite weaver-craft gorgeously gemmed with diamonds. The minute and almost microscopic gossamer, also, fabricates its mimic threads, and floats them through the air, or stretches them across gardens and fields.

The Farm.—Throughout September, all kinds of sheep continue wholly at grass. If a regular flock be not kept, the annual purchase may be made at any of the September fairs. A common system in many enclosed districts, where the fences are very secure, and the supplies of food are abundant, is to buy old crones in September, to put the ram to them in October, to sell the lambs as they become fat for the butcher, and so to fatten and dispose of the mothers that the whole may be cleared off in somewhat less than a year from the time of buying; but this system is, in general, inferior to that of wether lambs. Throughout the month, all cows, steers, and calves may be kept wholly at grass. Fattening beasts should be well looked to, and have food both good and abundant; for they are nice in their taste, and, if they do not receive ample pasturage of a quality quite to their taste, they will cease to fatten, and may even begin to decline. Dairy cows also must have plenty of grass, else their milk will be very liable to fail; or they may be profitably fed in a yard upon lucerne, mown green. Horses must be kept at full work; and, during the greater part of the month, they should continue to receive a portion of green food; toward the middle of the month, they must be taken from the grass for the night, and kept in the stable; and at the end of the month, they should cease to receive green food, and begin to be fed wholly on hay and oats. "Wheat-sowing," says Arthur Young, "is a business in which we usually stretch a point, and make the ploughs do

full work. Both horses and oxen should be kept this month to lucerne, &c., mown every day; they will work as well on it as on any other food; but while they plough, they must have oats and chaff with it; for no grass at this season of the year is so nourishing as it was in the summer."

The labours of harvest are continued from August. If the weather have been rainy, and the soil be cold, wet, and backward, wheat should be sown in September; but if the weather continue dry, or if the soil be comparatively dry and warm, it should not be sown till October. September is the proper time for cutting fern and stacking it in the farm-yard; for cutting wheat and rye stubbles, and carting them home to the farm-yard; for the picking of hops; for the ploughing of stubble-lands; for the water-furrowing of newly ploughed wet fields; for the sowing of winter tares; for hoeing late crops of turnips; and for dressing heavy soils with lime. Burnet fields and lands of the present year laid down to grass ought to be kept intact from the tread or approach of any stock. Lucerne will yield another cutting toward the end of this month, or early in October.

The Kitchen Garden.—The produce of the kitchen garden available for use in September comprises cabbages, savoys, broccoli, cauliflower, potatoes, turnips, carrots, beet, parsley, garlic, onions, leeks, eschalots, rocambole, radishes, horse-radish, melons, cucumbers, mint, mushrooms, pease, beans, artichokes, burnet, borage, spinach, sage, endive, fennel, celery, cresses, water-cresses, chervil, French fennel, marigold, marjoram, thyme, tansy, love-apples, lettuces, kidney-beans, purslane, mustard, savoy, and rosemary.—In September, sow lettuces, early in the month, in warm open ground, and, late in the month, in frames; prepare mushroom beds, and provide mushroom spawn; transplant lettuces to the open ground for early use, and to frames for winter use; transplant, in the third week of the month, into a warm and well-sheltered nursery-bed, the cauliflower plants of the August sowing; hoe, earth up, and otherwise encourage the cauliflower plants of the July planting; transplant cabbages, savoys, borecoles, and broccoli; prick out into nursery-beds the various plants of the cabbage species from the sowing of August; plant celery into trenches for a successional winter crop; tie up large endive plants to blanch; transplant endive into a warm and dry situation for winter's use; earth up, tie up, and blanch cardoons; thin and hoe the August sowing of spinach; hand-weed the July and August sowings of onions; thin and hoe the turnips of the August sowing; and make successional sowings of small salad plants on a warm border, or within the radiation of a south wall.

The Fruit Garden.—The home-grown fruits available for use in September are walnuts, almonds, filberts, apples, pears, chestnuts, cherries, plums, apricots, nectarines, peaches, raspberries, strawberries, mulberries, figs, grapes, currants, and gooseberries.—In September, regulate once more the shoots of vines, apricots, peaches, and other wall-trees; continue to protect wall fruit from insects and birds; make new plantations of strawberries; gather apples and pears; propagate gooseberry-bushes and currant-bushes by cuttings; and prepare, either from spring-sown seedlings or from present cuttings, layers, or suckers, a nursery of stocks for the grafting and budding of fruit trees.

The Flower Garden.—Toward the end of September, plant select hyacinth, tulip, polyanthus-narcissus, and other bulbs for early blooming in spring. About the middle of the month, begin a successional planting of ranunculuses and anemones. In the latter part of the month, transplant hardy evergreen shrubs, and many kinds of hardy deciduous shrubs. In the course of the month, remove and transplant

layered carnations; water such layered carnations as were formerly removed; gently water choice auriculas in dry weather, and protect them by covering in very rainy weather; transplant biennial and perennial plants, raised from spring and early-summer sowings, or from slips, offsets, layers, pipings, and divided roots; trim or plant edgings of thrift; clip such hedges as are still untrimmed; propagate many kinds of fibrous-rooted perennials from slips or offsets, or by division of the roots; and keep lawns, walks, and borders in a state of perfect cleanliness and order.

OCTOBER.

Phænomena.—October is frequently the most settled month in the year. Its prevailing temperature, as compared with the shortness of its days, is usually very high; yet this is largely occasioned by great radiation of heat from the soil; and, in some years, it is vastly reduced or occasionally overwhelmed by frosty and snowy premonitions of winter. The thermometer usually ranges between 35° and 54° by night, and between 50° and 65° by day; and it has a mean height of about 49° ; yet it not unfrequently falls below the freezing point by night, and has been known to rise so high as 77° by day. The barometer has a mean height of 29.6 inches; and usually ranges between 28 and 31.6. The mean fall of rain, on the average of many years, is about two inches; and the mean evaporation is nearly $1\frac{1}{2}$ inch. The winds are usually soft and comparatively lull; and, on the average of many years, they blow 3 days from about the north, 3 from about the north-east, $2\frac{1}{2}$ from about the east, $3\frac{1}{2}$ from about the south-east, $2\frac{1}{2}$ from about the south, 6 from about the south-west, $4\frac{1}{2}$ from about the west, and $6\frac{1}{2}$ from about the north-west.

In the early part of October, hollies and china bollybocks are in bloom, and the catkins of some kinds of willows are formed; in the middle parts, the leaves of the Spanish chestnut are yellow, those of the weeping-birch are bright red or gold coloured, those of the sugar-maple are scarlet, and most of those of the ash, and some robinias and horse-chestnuts, are fallen; and in the latter part of the month, the leaves of the marsh-elder have a fine pink colour, those of the stag's horn sumach are purplish red, and those of the American oaks have various tints of yellow, orange, red, and purple. A tempestuous snowy day, accompanied by one or two sharply frosty nights in October, sometimes suddenly reduces the flower-garden from beauty and brilliance to almost utter desolation; but when the whole month maintains its usually mild character, it retains to its very end a large proportion of the floral gorgeousness of September. Some of the most conspicuous flowers which adorn it are, in the shrubbery, passion-flower, evergreen cythus, broom, bramble, althæa, honeysuckle, roses, arbutus, and laurustinus; and, in the parterre, colchicums, cyclamens, golden-rods, pinks, pansies, stocks, sunflowers, china-asters, chrysanthemums, dahlias, verbenas, French marigold, African marigold, anemones, campanulas, nasturtium, Guernsey lily, pentstemon, salvias, fuschias, autumnal crocus, scabious, carnations, Indian pink, asters, balsams, adonis, lupines, sweet-sultan, and marvel of Peru.

In the early part of October, snakes and vipers commence their hybernation, and redwings, hooded crows, and wood-pigeons arrive; in the middle parts of the month, wild geese remove from the fens to the rye-fields, hen-chaffinches flock together preparatory to migration, and the snipe makes its appearance in the meadows; and in the latter part of the month, rooks visit their nest-trees, the tortoise begins to hybernate, spiders' webs abound in the hedges and in the fields, the woodcock returns, and some larks are occasionally heard. "The emigration and immigration of the

feathered race still take place. The hirundines or swallow-tribes have departed, and the water-birds are flocking hither from other shores. The starlings now congregate in multitudes, and do considerable mischief in the fenny countries, by settling on and breaking the reeds which grow there abundantly. Many animals and reptiles and insects now seek their winter quarters, and retire, as impelled by their several instincts, to await the return of all-reviving spring."

The Farm.—Much of the work proper to September may, by the backwardness of a season, or the prevalence of unfavourable harvest weather, be prolonged into October; and a considerable portion of the work proper to October frequently requires to be postponed till November. October weather, when understood with practical reference to the condition and operations of the farm, is the period of comparative or tolerable mildness which immediately precedes such an inclement transition to rain, snow, or frost, as puts an arrest upon most of the labours of the field.—October is commonly the month for hiring and stocking farms, or for removing from one farm to another; and, on such occasions, a large portion of it is necessarily consumed in the toils of stocking and removing. This is also the chief time for hiring farm-servants; and it demands consideration, not only as to the place and act of hiring them, but as to the number and the qualifications to be sought.

October will most probably terminate the pasture feeding of all kinds of stock for the year; so that the farm-yard ought to be in a state of perfect readiness for the winter's use. At the commencement of the month, all cows, steers, and calves may still be at grass; but, at some time in the progress of the month, when the temperature considerably falls, and the grasses fail to yield sufficient nourishment, they must be taken home to the yard, and variously fed according to their condition and their destiny. Dry cows may be fed on cut chaff; milking cows, in another yard, on cabbages and chaff; young cattle, on the same fare as milking cows; and fattening beasts, on turnips and chaff, or, what is better, on cabbages or carrots and chaff. Such cattle as have been soiling in the yard or sheds, may now have their food gradually changed to dry meat, cabbages, or roots. At the beginning of the month, ewe and wether hogs are still at grass; but towards the end of it, or when the pastures cease to afford proper nourishment, they must be penned on turnips. All sheep intended to be fattened, however, ought to be already half-fattened when they are turned on turnips; for if they leave the pastures and begin the turnips in a lean condition, they will by no means make a profitable return for their feeding. Selected rams ought, in the early part of the month or not later than about the 10th, to be turned in among the breeding ewes. Horses, according to the practice of some farmers, continue throughout much of October, to receive a portion of green food, and are not, till towards the end of this month, restricted to hay, chaff, and oats. Full grown hogs ought now to be put to fatten.

As soon as cattle are turned into the farm-yard, the labours of the barn for the supply of fodder and litter commence; and these labours are thenceforth continued till spring. In the course of October, the potato crop must be ploughed up, gathered, and stored; and about the end of the month, the carrot crop should be dug up and stored. Autumnal tillage of all wet or stiff lands ought to be busily prosecuted in October, for, in consequence of saturation with moisture, it may become impracticable in November; but the ploughing of very light sandy soils can be performed, during open weather, in any part of winter. The sowing of wheat ought to be much more general in October than in either September or November; for it is as suitable on lightish soils in

October as in September, and generally far more suitable in heavy soils in October than in November. Two successional crops of winter tares ought now to be sown. Successful bean husbandry upon harsh and difficult soils, chiefly depends upon the diligent ploughing and due manuring of the land in October, or, in favourable weather, in November. Ploughing for pease, for barley, for oats, and for madder must also be, at this time, diligently prosecuted. A very deep digging should at present be given for liquorice. In woodland districts, all fallen tree-leaves which can be obtained at moderate cost, should be collected and carted to the farm-yard for litter and conversion into manure. Water-courses ought to be examined, and kept freely open.

The Kitchen Garden.—The produce of the kitchen garden available for use in October, comprises, from hotbeds, mint, mushrooms, mustard, cress, lettuces, melons, and cucumbers; and from the natural ground, potatoes, turnips, carrots, beet, artichokes, cabbages, cabbage-sprouts, savoys, pease, beans, garlic, onions, leeks, rocambole, eschalots, cauliflowers, radishes, love-apples, broccoli, celery, fennel, chervil, French fennel, parsley, thyme, spinach, horse-radish, kidney-beans, sage, small salads, savory, sage, marjoram, and sorrel.—In October, sow beans, pease, radishes, carrots, lettuces, and small salad herbs; transplant lettuces, cabbages, borecoles, hyssop, thyme, savory, sage, and marjoram; uncover and cover, according to weather, the cauliflower-plants recently planted in frames; and, near the end of the month, transplant them into a piece of warm rich ground under hand-glasses; give a general hoeing to cabbages, borecoles, savoys, and broccoli; give a hand-weeding to winter spinach; make a successional tying up of endive plants for blanching; give a general weeding and winter-dressing to beds of hyssop, thyme, sage, mint, pennyroyal, tansy, marjoram, tarragon, balm, sorrel, burnet, and chamomile; cut down asparagus plants, give a winter dressing to asparagus beds, and commence the process of forcing asparagus for use in early winter; earth up celery and cardoons; dig up crops of potatoes, full grown carrots, some parsnips, and some beet-roots, and store them according to the methods suited to their respective nature; and commence the digging, trenching, and manuring of all vacant pieces of ground, in order that they may enjoy, throughout winter, all the fallowing advantages of sun, air, frost, and mineral decomposition. About the third week of the month, early purple broccoli should be put into pots; and toward the end of the month, a small planting of mint and tarragon for winter use may be made upon a slight hotbed or in pots or boxes.

The Fruit Garden.—The home-grown fruits available for use in October are walnuts, filberts, almonds, apples, pears, plums, cherries, peaches, nectarines, mulberries, grapes, raspberries, strawberries, gooseberries, and mat-preserved currants. During October, gather apples and pears; head down stunted and barren fruit-trees, in order to make them serve as stocks for new grafts; give the winter-dressing to strawberry plantations; propagate gooseberry bushes and currant bushes from cuttings and suckers; propagate some other fruiting plants by cuttings and layers; prune standard gooseberry bushes and currant bushes as soon as the wood of their young shoots is ripe; prune raspberry plants; and make new plantations of raspberry plants. About the middle or towards the end of the month, plant gooseberry bushes and currant bushes. In the latter part of the month, peach-trees, nectarine-trees, and apricot-trees, if their leaves have dropped, may begin to be unnailed; most kinds of fruit-trees may be safely transplanted; and a wash of water, lime, and cow-urine may be applied to fruit-trees, by means of a brush or an engine, for the destruction of mosses and lichens.

The Flower Garden.—In October, prune shrubs of all straggling and exuberant shoots; transplant all kinds of fibrous-rooted biennials and perennials; plant fibrous-rooted biennials and perennials in pots; plant most kinds of bulbous and tuberous-rooted flowering plants; cut away all dead stems of herbaceous perennials and tear up all decayed annuals; give a general weeding, cleaning, and winter-dressing to all borders and flowering compartments; plant all kinds of hardy shrubs and trees, whether deciduous or evergreen; prune rose-bushes, honeysuckles, and all such other flowering shrubs as require pruning, and remove from rose-bushes, lilac-trees, and all plants of similar habits, any suckers which they may have sent up; transplant ornamental trees; propagate deciduous shrubs by layering; prune and train evergreen shrubs; remove all pots and boxes of seedlings, and also, toward the end of the month, all potted auriculas, to a warm situation, fully exposed to the sun, and as well sheltered as possible from wind and cold; trim any edgings and hedges which were not trimmed in August or September; form box-edgings along walks and around beds; make edgings of thrift; plant hedges; clean and repeatedly roll gravel walks; give a close, even, and finishing mowing to lawns and grass walks; and remove to the greenhouse all such half-tender perennials as were brought out during summer and not placed back in September. See the article GREENHOUSE.

NOVEMBER.

Phenomena.—November has the reputation of being the foggiest month in the year. In some years, it is clear, calm, and mild; and in others, it is clear, frosty, and very cold; but in most, it is dark, unsettled, and stormy, and frequently wrapped in fogs and snows. "We are now," remarks Howitt, "in a month of darkness, storms, and mist,—of the whirling away of the withered leaves, and the introduction to complete winter. The flowers are gone; the long grass stands amidst the woodland thickets withered, bleached, and sere; the fern is red and shrivelled amongst the green gorse and broom; the plants which waved their broad white umbels to the summer breeze, now, like skeleton trophies of death, rattle their dry and hollow branches to the autumnal winds. The floral splendours of our gardens are dead; their walks are uninviting; and as these summer friends of ours are no longer affluent and of flourishing estate, we of course desert them." The whole month is, in general, damp with drizzling rains, long showers, or lazy and murky fogs; much of it is, not unfrequently, a season of ceaseless rains and sleets; and the latter part of it is usually a time of wild and stormy winds, and, in not a few years, has been a season of the most tremendous tempests. Winds from between the south-west and the north-west exceedingly prevail, and often blow with excessive violence, and are accompanied with extreme depression of the barometer. The temperature has a mean height of about 42°, and usually ranges between 30° and 54°; but it has been known to fall so low as 19°, and to rise so high as 63°. The barometer ranges between 28.01 and 31.17; and has a mean height of 29.65. The mean fall of rain, on the average of many years, is about 2½ inches; and the mean evaporation is about 0.76. The winds, on the average of years, blow 3 days from points about the north, 4 from about the north-east, 2 from about the east, 2 from about the south-east, 3½ from about the south, 5½ from about the south-west, 5 from about the west, and 5 from about the north-west.

Though very few plants come naturally into flower in November, and though nearly all the hardy autumnal flowering plants are, in many years, reduced to utter desolation by frosts and tempests in the early part of this month, yet a considerable number of

beautifully fruiting ornamental shrubs always adorn it with their fruits, several most handsome hardy shrubs and herbaceous perennials always adorn it with their flowers, and, in some years, many scores of species of the most brilliant and showy hardy flowers of autumn continue to bloom till near its close,—and a few quite past its close,—while several of the sweetest flowering-plants of spring lend to it by anticipation a considerable portion of their bloom. We observed, on the 22d of November, 1844, in the open ground of a small cottage garden, so far north as the border of the Scottish highlands, no fewer than about fifty select species in flower, including some of the most brilliant dahlias, and some of the choicest and most tender kinds of such genera as pentstemon, verbena, and alonsoa. Among the most frequent and conspicuous floral ornaments of the open ground in November, are, in the shrubbery, arbutus, laurustinus, roses, china-roses, passion-flower, honeysuckle, and evergreen cytissus; and, in the parterre, dahlias, golden-rods, Indian chrysanthemums, asters, china-asters, colchicums, anemones, daisies, violets, stocks, wallflowers, auriculas, primroses, and polyanthes.

In the early part of November, the golden plover appears, and the buck emits his peculiar cry; in the middle part of the month, snails and slugs disappear from view, and commence their hybernation; and in the latter part of the month, greenfinches congregate, and the winter moth and the common flat-body moth make their appearance. In the course of the month, the widgeon, the stock-dove, and some other birds, including the golden plover, appear; the migratory birds which contributed a quota of cheerfulness to our summer are no longer to be seen, and their successors are fewer in number, less mirthful, and more shy and seclusive; the frog sinks to the bottom of ponds and ditches, and buries itself in the mud; the lizard, the badger, and the hedgehog creep into holes in the earth and into similar other retreats, there to lie torpid till spring; the dormouse sinks into a winter slumber; squirrels, rats, and field-mice shut themselves up with their winter stores; and bats retire into old barns, caves, and deserted buildings, and there suspend themselves by their hind feet, and wrap themselves in the membranes of their fore-feet, either to pass the whole winter in one uninterrupted sleep, or to experience a temporary awaking only during some interval of unusually mild weather.

The Farm.—The young ewes and wethers of last spring's lambing must continue, throughout November, to be penned on turnips; and their pens, when necessary, must be shifted. Lean stock sheep may still be kept on the remains of the summer grass, and on the sheep walks; but all fattening and fat sheep must be kept on turnips, or cabbages, or similar food, and ought to receive as much as they can possibly eat, yet without being allowed to occasion any waste. Rams and breeding ewes ought to continue to herd together upon pastures till about the middle of the month; but, at that period, the rams should be withdrawn. All black cattle continue, throughout November, in their respective yards; and such of them as are designed to be fattened, ought to be fed at least on turnips, cabbages, or potatoes, and, if possible, on carrots, or, best of all, on parsnips. Horses continue, through the early part of November, to receive full allowance of hay and corn; but, very generally, they begin, before the middle of the month, to have little work, and to suffer a total withdrawal of their hay, and a great diminution in their allowance of corn. Yet, with thoroughly good farmers, horses ought, even at this season, to be fully employed, and constantly well fed. "There are," remarks Arthur Young, "many works for horse-labour that may be executed in this month after ploughing is finished; on light dry soils, the marl,

chalk, or clay carts should not stop; they may work from the first day to the last; and in wetter soils, you may cart any sort of manure on to grass lands, provided you use small carts." About the beginning of the month, colts should be put into a yard, or into a paddock provided with a shed, and should be fed on straw and succulent roots, such as potatoes or turnips. Swine and poultry should be fed and treated as in preceding months.

The labours of the barn for the supply of fodder and litter to the farm-yard must be so continued as to render the supply ample and regular. The ploughing of stubble land for fallow-crops or for bare fallow must proceed according to the circumstances of suitable weather and practicable character and condition of the soil. The carting home of turnips must be sufficiently frequent or ample to afford a full supply for the uses of the farm-yard; and, in general—though this rule must be modified by certain conditions of either soil, crop, stock, or point of rotation—every two or three alternate drills of the turnips should be taken up and carted home, and the remainder left upon the ground for the penning of sheep. November is the first suitable month for hedging and ditching; and the whole of it, when the state of the weather permits may be employed in operations upon the live fence, in ditcher-work, in draining, and in all sorts of farm labour with the pick-axe and the spade. The borders of fields should now be thoroughly cleaned from thorns, brambles, thistles, and other kinds of rubbishy and mischievous vegetation; the winter-watering of meadows may now be commenced; stone-fences and other dry stone walls may be built; mineral manures, such as marl, chalk, clay, and ditch-earth, may be carted; ant-hills on pasture fields should be destroyed; water-furrows which retain stagnant water should be cleansed; the vastly important, heavy, and operose work of hollow draining, in all its methods and departments, may be performed; the work of wood-cutting ought to be commenced; the carting home of sufficient supplies of fuel ought to be attended to; and fish-ponds, when thought desirable, may now be formed. Toward the end of the month, the hardy hog-pea may be sown on such dry soils as are susceptible of good winter tilth.

The Kitchen Garden.—The produce of the hotbeds of the kitchen garden available for use in November, comprises asparagus, mushrooms, mint, and lettuces; and that of the natural ground comprises turnips, potatoes, carrots, parsnips, beet, borecoles, cabbages, cabbage-sprouts, savoys, horse-radish, garlic, onions, leeks, rocambole, eschalots, salsafy, radishes, scorzonera, cauliflower, broccoli, celery, marjoram, lettuces, artichokes, water-cresses, thyme, cardoons, savory, chervil, endive, parsley, spinach, sorrel, salsafy, pease, and skirrets.—In November, sow pease, beans, radishes, carrots, and small salad herbs; give lettuce and cauliflower plants in frames as much air as can comport with their perfect protection from frost; tie up large endive plants in dry weather, to blanch; hoe cabbage and borecole grounds; earth up the last of the advancing cardoons; plentifully cover sea-kale with sea-weeds or with other suitable covering; commence the forcing and blanching of sea-kale; prune, earth up, and otherwise winter-dress artichokes; take up carrots, parsnips, beets, and other similar roots, and store them in sand; clean the rising crops of winter onions from weeds; make hotbeds for asparagus; and manure, top-dress, dig, and trench all vacant spaces of the kitchen garden.

The Fruit Garden.—The home-grown fruit available for use in November comprises apples, pears, walnuts, chestnuts, filberts, hazel-nuts, almonds, strawberries, medlars, twice-bearing raspberries, plums, quinces, services, mat-preserved currants

bag-preserved grapes, and a few late peaches and nectarines.—In November, nail and prune vines; preserve grapes for winter use; prune apricot-trees, peach-trees, and nectarine-trees; plant plum-trees, cherry-trees, peach-trees, nectarine-trees, apricot-trees, pear-trees, and apple-trees, for growth upon walls and espaliers; prune cherry-trees, plum-trees, apple-trees, and pear-trees, on walls and espaliers; store apples in approved methods for preservation; remove all unripe fruit from fig-trees; prune gooseberry bushes and currant bushes; plant gooseberry bushes and currant bushes; prune and plant raspberry plants; plant and dress strawberry beds; plant filbert-trees, hazelnut-trees, fruiting barberry bushes, walnut-trees, chestnut-trees, service-trees, mulberry-trees, quince-trees, and medlar-trees; and prune away exuberant growths, remove straggling shoots, and cut out decayed wood and worn-out bearers from standard apple-trees, standard pear-trees, and other kinds of standard fruit-trees.

The Flower Garden.—In November, plant most of the spring and summer flowering kinds of bulbous and tuberous-rooted plants; transplant monkshood, irises, golden-rod, perennial sunflower, lily-of-the-valley, and many other kinds of hardy perennials; plant campanulas, sweetwilliam, rocket, carnations, columbines, stocks, wallflowers, and many other kinds of hardy perennials and biennials; cut away all dead stems of perennials; remove decayed annuals; plant bulbs in pots and in water-glasses; shelter and protect potted auriculas, potted carnations, and all kinds of choice seedlings; cover fuschias, select carnations, and other nearly hardy plants, which incur some risk of damage from the weather; prune evergreen and deciduous shrubs; dig and clean the soil of the shrubbery; protect the roots of newly planted shrubs and trees; protect also the roots of garryas, arbutuses, myrtles, magnolias, and similar slightly tender shrubs; exercise special care over beds of anemones, ranunculuses, and choice hyacinths and tulips; prepare compost for flower-pots and flower-beds; plant and clip hedges of thorn, hornbeam, privet, beech, elm, yew, and holly; plant edgings of box or thrift; and reduce lawns, grass-walks, gravel-walks, and the whole garden to perfect order.

DECEMBER.

Phenomena.—December is sometimes designated the gloomiest month in the year; yet it has very generally a mere continuation of the characteristics of November, and is sometimes exceeded by that month in the aggregate of real gloom and disagreeableness. In some years, it has prevailingly a dry, bracing frost; in others, it has an almost uninterrupted series of fogs, and drizzling rains; in others, it maintains, till near its close, a considerable proportion of the clearness and mildness which characterize a remarkably fine autumn; in many, it acquires, toward its close, a stern, relentless, wintry character; and in most, till near its end, it possesses a combination of wetness, storminess, and comparative mildness. South-west winds usually prevail during about one-fourth of the month, and are sometimes violent, and accompanied with heavy rains, and occasionally with thunder. Easterly and north-easterly winds frequently prevail during five or six days, and are usually accompanied with frost. The commencement of severe or actual winter generally occurs in the latter part or towards the end of the month; and is not unfrequently preceded by calms, fogs, and heavy rains. The thermometer has a mean height of about 39°, and usually ranges between 17° and 55°; but it has been known to fall to two degrees below zero, and to rise so high as 58°. The barometer has a mean height of 29.69 inches, and usually ranges between 29.12 and 30.32. The mean fall of rain, on the average of many years, is 2.47 inches; and

the mean evaporation is 0.6 of an inch. The winds, on the average of many years, blow one day from points about the north, 2½ days from points about the north-east, 3½ from points about the east, 4 from points about the south-east, 2 from points about the south, 8½ from points about the south-west, 6 from points about the west, and 4 from points about the north-west.

Almost all annual plants of our country, whether indigenous or introduced, exist during December only in the epitomized and hybernating form of seed; and the vast majority of other plants are in a state of profound repose, resting their roots dormant beneath the surface of the soil, and escaping the damage or destruction which their delicate organism would otherwise sustain from the rigours of frost or from alternations of frost and sunshine. In mild seasons, a few of the autumnal flowering plants continue their bloom into December, and even beyond its close, and a small number of vernal-flowering plants bloom more or less freely in anticipation; but, in most instances, both classes have a sickly and drooping appearance, and afford abundant indication of being completely out of their natural season. Yet the daisy and some chrysanthemums often bloom in great brilliance; and hellebores, cyclamens, pansies, anemones, wall-flowers, stocks, polyantheses, and primroses, not infrequently rise far above sickness, and altogether astonish a novice by the comparative flushness and fulness of their floral beauty. All the evergreen shrubs, also, and many of the evergreen herbs, contribute to the garden and the villa-ground features of refreshing and most welcome verdure; and a few, such as the laurustinus, the arbutus, and the evergreen cytisus, contribute the additional and far richer feature of floral bloom. The mosses and the liverworts, however, are unchecked in vegetation; and, though simple in organism, and individually minute, they impart an agreeable verdure to close scenes, and afford an interesting subject of botanical investigation during all the wintry night of the general sleep of plants.

During December, almost all insects which have escaped destruction are inert in their winter-torpor; but respectively in the beginning and toward the end of the month, appear the December moth and the yellow-line quaker; and on warm days, a few gnats may be seen sporting in the sunbeams. Reptiles and other animals which have torpid habits of hybernation, as the lizard, the frog, the hedgehog, and the badger, are also everywhere out of view. Yet such of our indigenous or naturalized animals as retain the exercise of their instincts, perception, and locomotivity, become more confiding in man, and excite much more tender feelings of interest than during summer or autumn; and various agreeable families of the feathered tribe, urged hither by increasing scarcity of food in their native haunts, arrive upon our shores, and pleasantly vary our specimens of animated nature. The web-footed birds from the arctic regions, and the timid and suppliant wrens, thrushes, blackbirds, sparrows, and robin redbreasts of our own land, specially challenge the attention, and interest the feelings, during the snows of December.

The Farm.—All kinds of cattle, throughout December, continue to be constantly in the farm-yard, and must be treated in the same manner as in November. The littering of the yards, stalls, stables, cow-houses, hog-sties, and cattle-sheds, ought to be so regular, constant, clean, and plentiful, as both to keep all the stock in a comfortable condition, and to prevent the loss of any manure. The ewe and wether hogs ought, throughout this month, as throughout November, to be kept folded on turnips. The ewes should continue to be on grass; but, during snow or hard frost, they must receive an allowance of hay; and should any of the forward ewes

lamb, they must be better kept than before, and receive a plentiful allowance of cabbages or turnips. During very severe weather, sheep should be brought under shelter. Horses, in consequence of the shortness of the days and the occasional inclemency of the weather, cannot at present work full time; and may be kept on a modified allowance of straw and corn. Colts should be kept in their yard or paddock, on straw and an allowance of green food. All swine ought to be kept well littered, so as always to be perfectly clean, and to have their skins of a bright and healthy appearance; and all fat swine, in particular, should be kept thoroughly tidy, and constantly littered up to their belly.

All lands designed for either fallow-crops or bare fallow ought, in ordinary circumstances, to be so tilled before the end of December as to be laid out to enjoy the pulverizing, cleaning, and mellowing effects of the winter's frosts. The labours of the barn must be so attended to throughout the month, as to furnish the requisite supplies of fodder and litter. A supply of pulled and carted turnips ought to be stored under a shed or in some other suitable place, as a preparation against the sudden or prolonged assaults of snow or tempestuous weather. The hedgers and ditchers ought to be constantly at their appropriate work throughout December, so as to be disengaged for other labour in spring. In weather unsuitable for ploughing, the carts ought to be constantly at work in taking home marl, chalk, clay, and ditch-earth, and in removing farm-yard manure into heaps on the fallow-fields. Water-meadows may be flooded, improved, and extended; and the operose labours of draining may be continued.

The Kitchen Garden.—The produce of the kitchen garden available for December comprises turnips, carrots, parsnips, beet, cabbages, cabbage-sprouts, borecoles, savoy, broccoli, cauliflower, potatoes, garlic, onions, leeks, eschalots, rocambole, radishes, horse-radish, parsley, spinach, celery, cardoons, thyme, scorzonera, lettuces, sage, marjoram, sea-kale, water-cresses, endive, salsafy, and sorrel.—In December, remove all decayed leaves from cauliflower plants in frames; remove all pots of early purple broccoli into a frame, a pit, or a shed; sow successions of small salad herbs; sow a few lettuces on a warm south border; give air to lettuce-plants in frames; sow short-top radishes toward the end of the month; sow pease and beans in warm or well-sheltered ground; try a sowing of carrots on a warm border; earth up celery on a mild day, and when the soil is dry; tie up large endive plants to blanch; earth up cardoons to blanch; earth up artichokes, or cover them with litter; defend mushroom-beds from frost and rain, and keep over them a covering of clean straw a foot thick; make an asparagus hotbed for affording a supply late in winter and early in spring; and dig and trench all vacant spaces of the kitchen garden ground.

The Fruit Garden.—The home-grown fruit available for use in December comprises walnuts, chestnuts, almonds, filberts, hazel-nuts, apples, pears, quinces, strawberries, services, and medlars.—In December, prune into regularity any standard fruit-trees which require the application of the knife; prune vines, plum-trees, cherry-trees, pear-trees, and apple-trees, on walls and espaliers; remove moss and cracked bark from the stems and branches of fruit-trees; protect the roots of newly-planted fruit-trees from frost; support with stakes all such recently-planted fruit-trees as are liable to be damaged or overthrown by high winds; dig manure into such fruit-tree borders as have a poor soil or are in an exhausted condition; transplant, in open weather, any young fruit-trees which it is still thought desirable to remove; make new raspberry plantations

in open weather; look over the fruit in the fruit-room; and destroy all chrysalides which can be found under the copings of walls and gates, or in any other situation in or near the garden.

The Flower Garden.—In December, protect choice plants in the open ground from frost, snow, and heavy rain; afford special protection, and give alternations of covering and exposure, to potted auriculas, potted carnations, and other plants in pots, frames, under glasses, and in specially sheltered situations; place a succession of hyacinths, polyanthi-narcissi, Persian irises, early dwarf tulips, and other similar bulbs in water-glasses; give occasional protection to beds of hyacinths, tulips, anemones, and ranunculuses, in severe weather; give careful attention to tender seedlings; protect the roots of the finer kinds of newly-planted shrubs and trees; prune such ornamental shrubs as require the application of the knife; take up the suckers of roses and other flowering-shrubs, and plant them in a nursery-bed; dig, in open weather, the borders, beds, and figured compartments of the lawn and the parterre, the clumps and expanses of the shrubbery, and such grounds or spots as are intended for new plantations of trees, shrubs, or flowering-plants; prepare some composts, and bring home materials for preparing more; plant hedges of hawthorn, elm, hornbeam, beech, privet, barberry, blackthorn, elder, or any other kinds of deciduous shrubs; and plash or lay down such hedges as have become open and inefficient at bottom, and tall, coarse, and irregular at top.—*Young's Farmer's Calendar.*—*Low's Elements of Agriculture.*—*The Farmer's Almanac.*—*The Gardener's Gazette.*—*Loudon's Encyclopædia of Agriculture.*—*Marshall's Reports.*—*The Gardener's Magazine.*—*Mawe's Gardener's Calendar.*—*The Gardener's New Calendar.*—*The Knowledge Society's British Husbandry.*—*Keith's Botanical Lexicon.*—*Adam's Roman Antiquities.*—*Buffon's Natural History.*

CALENDULA. See MARIGOLD.

CALF. The offspring of the cow. The varieties of the calf, the modifications of its constitution achievable by the art of breeding, and the accidents to which it is subject in the foetal state and in the process of birth, are discussed in the articles CATTLE, COW, BREEDING, ABORTION, and PARTURITION. Some means of ascertaining the pregnancy of cows at an early period of their gestation, or of closely calculating the number of calves which will in one season be produced by a herd of cows, would be of considerable practical advantage to farmers who keep a large breeding stock. A common rule is to reckon every cow pregnant who does not return to the bull for six weeks after being bulled; but this rule is exceedingly fallacious, and might mislead a farmer to overestimate the number of his pregnant cows to the egregious degree of more than one half. A method has been suggested by a very able and experienced veterinary surgeon as easy and conclusive,—that a person may, at a very early period of a cow's gestation, place his ear close to her flank, and hear the double pulsation of the foetus; but this method has been pronounced by eminent judges who have tested it a mere delusion,—not the slightest intimation of the existence of the foetus being perceptible by any ordinary ear. Nay, says Earl Spencer, "I have tried the use of a stethoscope, but from want of practice in the manage-

ment of the instrument, or from some other cause, I have with this also been equally unsuccessful. I have also seen a surgeon, well accustomed to the use of a stethoscope, try it and fail as completely as myself." Other methods have been proposed; but most or all are subject to the very grave objection of a liability to cause abortion. The method of punching the cow in the flank, indeed, is quite conclusive, and unless when performed with unnecessary violence, is perfectly safe; but it cannot be practised until a cow has been at least six months pregnant, and it is therefore of very small practical value.

A method of proximately calculating the number of calves which any herd of cows will produce in a season was based on observation, and afterwards put to the test by Earl Spencer. He noted fifty cows in succession who did not return to the bull within six weeks; he then noted how many of these went seven weeks, eight weeks, nine weeks, and so on to twenty-one weeks; and he repeated his observations upon seven other series of fifty cows each, till his facts included four hundred bulled cows who did not within six weeks return to the bull. The following table exhibits the results.

6	7	8	9	10	11	12	13	14	15	16	17	18	21	Preg- nant	Calves.
50	45	41	39	38	37	34	33	32	32	30	29	28	26	26	26
50	44	35	33	32	30	28	27	27	26	26	26	26	25	23	23
50	41	38	36	31	31	30	29	28	27	27	27	27	26	23	17
50	45	41	36	34	31	30	27	26	26	26	26	26	24	20	16
50	47	44	43	43	43	43	40	39	39	37	36	36	35	33	31
50	45	42	36	35	34	32	30	28	24	24	24	24	23	20	18
50	42	41	39	37	36	35	32	31	30	30	30	30	28	26	24
50	48	47	41	41	39	39	36	36	36	34	34	34	31	29	26
400	357	338	305	292	283	272	255	245	241	235	232	232	221	202	181

He next made observations upon one thousand bulled cows, in five series of two hundred cows each, with the view of ascertaining the proportion of that number who should not within six weeks return to the bull. The results were as follow.

Bulled.	3 weeks.	4 weeks.	5 weeks.	6 weeks.
200	158	115	107	87
200	137	92	85	71
200	142	87	80	72
200	148	94	81	78
200	139	87	74	63
1000	724	475	427	371

Earl Spencer, in order to test these tables, founded upon them a number of calculations as to the probable number of live calves he should have in a season from each of several herds of cows, and, in every instance, found the calculated number to be remarkably near the actual number produced. For example, he calculated on the 22d of October, 1838, that he should have 48 live calves previous to the 1st of August, 1839, and he had 49; and he calculated, on the 24th of January, 1839, that he should have 53 live calves previous to the 1st of November, 1839, and he had 55. The principle of his calculation is very

obvious, and may, with much practical advantage, be adopted by every farmer who possesses a considerable breeding stock. "Taking the first table," says the Earl, "I divided the sum total of the cows in calf by the sum total of the numbers in each of the previous columns, and the decimals which will be the product of such divisions will show the probability of a cow proving in calf who shall not have returned to the bull at the end of each week respectively. This process I apply to ascertain the probabilities in the other table. I then multiply the number of cows who have gone twenty-one weeks by the decimal belonging to this column; the number who have gone eighteen weeks and not twenty-one, the number who have gone seventeen and not eighteen, and so on, by the decimals respectively belonging to these columns. I add the products of these multiplications together, and the sum total gives the probability of the whole list: I mean it gives the probable number of cows who will prove in calf. From this must be deducted the number who will probably not produce live calves, which will be about one in ten. With respect to the other table, I treat it in the same manner, and assume the probable number of cows to go six weeks as if they had actually gone that period, and add it to the first column of the first-mentioned table."

When a calf is born, the cow, by an instinctive prompting, ought instantly to lick off the slimy or mucous matter with which it is covered; and, in any instance in which she may seem disinclined to do this, she may readily be coaxed to it by the sprinkling of a handful of common salt over the calf. If, after the calf is cleaned and has begun to suck, the navel-string should continue to bleed, a ligature ought to be fastened round it very near, but not in contact with the belly. If the place at the division of the cord should be unusually sore, it must not, by any means, be touched with any caustic application, but ought to be dressed with a little tow, dipped in Friar's balsam, made fast with a bandage, and renovated every evening and morning. An inflammatory state of the navel, in some instances, is afterwards induced; but this will be noticed in the article NAVEL-ILL.

Many persons, even with the sanction of so experienced and popular a writer as Clater, take away about a quart of the beastings or first milk of the cow before permitting the calf to suck; and not a few of these give the calf, as its first aliment, about half-a-pint of lukewarm gruel. But, in every instance, whatever subsequent treatment may be intended, the calf ought to receive, not only the first beastings, but the whole of the milk until it becomes perfectly fit for dairy use. The first milk possesses an aperient power of clearing away the glutinous faeces which had accumulated in the intestines of the foetus, and which obstruct the due performance of the intestinal functions of the calf, and exert a ten-

dency toward the origination of disease ; it also possesses a peculiarly nutritive power, and a strongly viscid condition, well adapted and most evidently intended for the early invigoration and support of the young animal ; so that to withhold it is to contravene the wise provision of the all-beneficent framer of the animal economy, and to incur the certain hazard of damaging the young animal's health, and seriously diminishing its value. "Nature," remarks Mr. Marshall, "has evidently prepared milk of a peculiar quality for the infant calf ; and this milk is useless in the dairy : it is therefore doubly good management to suffer the calf to remain at the teat, until the milk becomes useful in the dairy ; which it usually does in two or three days. But although it becomes, to general appearance, similar to that of a cow which has been longer in milk, it is highly probable that it is still singularly adapted to the yet infant state of the calf. In the suckling-houses round the metropolis, it is well understood, that putting a young calf to a cow which is old in milk, will throw it into scouring."

The destination of calves, whether for early slaughter, for fattening into fine condition on milk, or for rearing to maturity in connexion with either grazing or the dairy, must depend partly on a farmer's notions of stock-management, partly on the character and economics of his farm, and very largely on his comparative distance from a good veal market. In dairy districts, many female calves and almost all male ones are slaughtered when very young,—most of them when only one or two days old. Yet the flesh of all unfed or but slightly fed calves is both unpalatable and unwholesome, and is popularly denounced by the Lowland Scotch as "slink veal," and sarcastically known among the Irish bogtrotters as "staggering bob," and is prohibited from use, on pain of civil penalty, among both the Swiss and the French. In pastoral districts, especially such as are far from markets, calves require to be carefully reared as grazing-stock, and therefore incur small hazard of being hurriedly surrendered to the slaughter ; and in many a dairy district, where their existence is at present tolerated only for the sake of milk, and where it is generally brought to a very speedy termination, they might, with a little better management, be made good food and the occasion of fair profit. So very competent a judge as Mr. Aiton of Hamilton does not hesitate to say, respecting the early slaughtering of calves in so fine a dairy district as that of Strathaven, "This is certainly bad economy,—for as milk can not be turned to more profitable account than in feeding calves till they are from four to six weeks old, it must be bad management to kill any of them when only a few days old. Veal, when moderately fat, is an excellent species of animal food, and can be brought to market with greater profit than either beef or mutton. The feeding

of calves is a simple and easy process ; and as the milk of a cow should not be used as human food till a week after she has calved, and as milk cannot be more profitably used than in feeding calves for a few weeks, it betrays great ignorance and want of economy to kill any of them till they are fed on the milk of their dams for at least four weeks. This is generally done in France, Belgium, and Holland ; and no person in these countries will taste the milk of a cow, till about a week after she has dropped her calf." As a general rule, however, every farmer ought to calculate whether the milk of his cows will yield the largest returns when used for butter, for cheese, for veal, or for pork and bacon ; and will find a large element in his calculations for veal, or for the milk-fattening of calves, to be nearness to a market in which veal brings good prices and is in steady request. Fat calves can be safely removed from place to place only by carriage ; and when the distance to a good market for them is great, the expense of carriage may decidedly counterbalance the profits of sale. So powerfully does the mere circumstance of distance from market control the uses of milk in the districts around London, that the whole country, as far as the influence of the London market can be felt, is divided into successive zones for respectively milking, calf-fattening, butter-making, cheese-making, and pork-fattening. The zone immediately around London, to the breadth of about eight or ten miles, is devoted to the supply of the metropolis with milk ; the next zone, to the distance of from ten to thirty miles from London, is devoted to the suckling of calves and lambs, for the supply of veal and lamb ; the third zone, to the distance of from thirty to seventy or eighty miles from London, is devoted to the supply of fresh butter ; and the districts beyond the third zone are partly of miscellaneous character, partly controlled by nearer markets, and partly devoted to the supply of bacon and ham.

Every farmer within the suckling district for the supply of veal to London, keeps from six cows to upwards of a dozen, and employs all their milk in the feeding and fattening of calves. He sells cows which cease to give milk, and buys others which are far advanced in pregnancy ; and thus contrives to have a constant and nearly uniform flow of milk. If his cow-house be single, it is fitted up with a range of calf-pens behind the cows ; and if it be double, it is occupied with pens, from end to end, along the middle. The pens are boarded enclosures, merely large enough to allow the calves to turn themselves, four feet high, floored with pierced boards, raised at least one foot above the earthen floor, and provided with a small box or manger, to contain some chalk as a remedy against fever. The stages used in Gloucester for pail-fed calves, are pronounced by Mr. Marshall to be of "an admirable construction," and described as fol-

lows:—"The house or room-stead in which a stage is placed, measures twelve feet by eight. Four feet of its width are occupied by the stage, and one foot by a trough placed on its front, leaving three feet as a gangway, into the middle of which the door opens. The floor of the stage is formed of laths, about two inches square, lying lengthway of the stage, and one inch asunder. The front fence is of staves, an inch and a half in diameter, nine inches from middle to middle, and three feet high; entered at the bottom into the front bearer of the floor, (from which cross joists pass into the back wall,) and steadied at the top by a rail, which, as well as the bottom piece, is entered at each end into the end wall. The holes in the upper rail are wide enough to permit the staves to be lifted up and taken out, to give admission to the calves, one of which is fastened to every second stave, by means of two rings of iron joined by a swivel, one ring playing upon the stave the other receiving a broad leather collar, buckled round the neck of the calf. The trough is for barley-meal, chalk, &c., and to rest the pails on. Two calves drink out of one pail, putting their heads through between the staves."

The best method of treating a calf with the view of fattening it, is to feed it entirely on milk fresh from the cow, either by allowing itself to suck her, or by drawing off the milk and administering it in a pail. The allowing of the calves to suck was at one time the general method, and is still the prevailing practice of some districts; and it is frequently vindicated on the ground of its causing a free secretion of saliva, and in consequence occasioning a readier digestion and a more rapid growth. But the abundant secretion of saliva can easily be promoted, in the pail-feeding method, by placing an artificial teat in the calf's mouth while feeding, and by preventing him from taking up the milk with unnatural haste. The fixing of a piece of clean leather, about three inches in length, to the bottom of the pail, the placing of the dairymaid's finger in the calf's mouth, or any other similar contrivance to act in the manner of a teat, will cause a perfectly sufficient flow of saliva simultaneously with feeding; and, by keeping a lump of chalk constantly within the animal's reach, he will at all times, by licking it, be induced to swallow much saliva which would otherwise drop from his mouth and be lost. Even though the sucking method were considerably the best for the calf, it acts very injuriously on the lactiferousness of the cow, and occasions a great ultimate loss. A good cow yields more milk than can be consumed by a young calf, and she soon becomes so fond of the calf that she will not yield her milk to the dairymaid; and unless her udder be completely emptied at every milking, she suffers a gradual diminution in the lactic secretion, and will necessarily and somewhat rapidly yield less and less till she become quite dry. But, in the pail-

feeding method, every cow is made to produce milk as amply and prolongedly as possible; every calf receives enough of milk for its sustenance, and no more; a feeble calf does not occasion a diminution of milk in one cow, and a strong calf can be fed partially or wholly with the milk of a second cow; and any calf, reared for stock, may be weaned by degrees, or have other food slowly and increasingly substituted for milk, so as to prevent injury to its stomach from a too sudden change of food.

A singular practice which prevails in some great suckling districts, renders the first stage of pail-feeding somewhat critical. Multitudes of calves which are fed and fattened in the suckling districts, are brought to them, by professional calf-dealers, from the dairy districts; and the animals are, in many instances, carried from so great a distance and in so injurious a manner, as to be half-dead on their arrival. They are conveyed on flat, shallow carts, their four feet tied together, their heads hanging over, and their stomach, for whole days, unrefreshed with food or drink; and, when they arrive, some die, and most require to be carefully nursed, and very gently treated. "If they are allowed to satisfy their appetite at first," says Mr. Rham, "they invariably *scour*, that is, purge violently and die. If the strong astringent medicine sold in the shops for the scouring in calves is given to them in this weak state, it only accelerates their death. The best remedy is to boil the milk for them, and give them little at first; to mix some starch or arrow-root with it, and to give them a raw egg beat up in milk. This restores the strength of the stomach, and generally cures them. When the calf begins to thrive on the milk which he sucks, or which is given him warm from the cow, nothing more is necessary than to keep him extremely clean and dry, to give him plenty of air, but not much light, and never to disturb him between his meals."

Some calf-suckling farmers give two meals of milk in the day, and others give three. Some give the milk sparingly at first, in order to whet the appetite, and prevent a loathing of food; and others give a plentiful supply from first to last, and merely use care not to allow a surfeit. Some, in order to produce superior flesh and a high degree of fattening, feed the young calves on the first-drawn milk, which contains a larger proportion of serum than the last-drawn milk, and feed the more advanced calves increasingly on the last-drawn milk, till they receive, for a time, that of two or even three cows; and a few, in order to prevent scouring, and economize the profits of feeding, feed all calves on artificially heated milk, and rearing calves on heated milk deprived of its cream. An extraordinary instance of the latter, in the vale of Gloucester, is mentioned by Mr. Marshall. "In the practice of the first breeder in the vale," says he, "the milk was given to the calves scalding hot,—as hot as the

dairy-girl could bear her hand in it. The lips of the calves were not unfrequently injured by it. His reasons for this practice were, that the heat of the milk prevented the calves from scouring, made them thrive, and enabled him to put his rearing calves to skim milk, immediately from their being taken from the cow, or at least two or three days old. They never tasted 'best milk' after they were taken from the teat at that age."

Some calf-feeders mix eggs with the milk given to advanced fattening calves, others mix meal with it, and others try different though similar methods of increasing the amount of assimilated nourishment; and not a few, when milk is scarce, give wholly or partially, as substitutes for it, a mixture of warm milk and meal and water, a mixture of linseed jelly, hot water, and hot milk, a mixture of powdered oil-cake and warm milk, or even so monstrous a medicament as balls of meal and water with a little gin. But all such artificial methods are at once unnatural to the animal's habits, deteriorating to its flesh, and unprofitable to the owner. Whenever thoroughly good milk is not quite abundant, some of the largest and best fattened calves ought immediately to be sold, and all the rest fully fed on milk. "The whole secret of fattening calves for veal," says Mr. Aiton, "is to give them, after they are three or four weeks old, abundance of milk, keep plenty of dry litter under them in their stalls, let them have the benefit of good air, moderate warmth, and be nearly in the dark."

Calves acquire the condition of prime veal in the course of from eight to twelve weeks, or, on the average, in about ten weeks. A good fattened calf usually weighs from 17 to 20 stones, of 8 lbs. each, and usually sells, in Smithfield market, at from 4s. 6d. to 5s. 6d. per stone. Yet the largest and heaviest does not always fetch the most money; for a calf of 14 or 15 stones, if of the proper age, and thoroughly fat, often sells for a shilling or two more per stone than a calf of from 20 to 30 stones. Some farmers, however, are of opinion that, as a calf grows and fattens faster, and requires less milk, after ten weeks of age than before, one calf of 25 stones will really yield a larger clear profit than two calves of each 15 stones; especially as the former case involves only one prime cost and one sale commission, while the latter involves two prime-costs and two sale-commissions. But both the absolute and the comparative profits are greatly modified by the manner of feeding, the distance from market, and the particular breed to which the fattened calves belong. The profits in the vale of Strathaven are far superior to those of the Liverpool and the London districts; and they appear to be affected, partly by the quality of the breed, and chiefly by the method of fattening; the profits of the hither side of the London district are necessarily greater than those of the further side; and the profits of a breed which

produces whiteness as well as firmness in the veal are always greater than those of inferior breeds,—butchers always giving the best price for the whitest flesh, and being in the habit of judging of the colour from the inspection of the interior of the mouth and the white of the eyes.

When calves are intended to be reared as stock, all males which are not well formed, and all females which have not a broad pelvis and a perfect udder and teats, ought to be rejected; and at the end of a month, all the selected males, not designed to be reared as bulls, ought to be castrated. Wherever milk is in low request for the market or the dairy, all calves will be reared in the best possible manner by being allowed to run during a year with their dams; but wherever milk is valuable, they must be sooner or later weaned,—in some districts at the end of a few days, and in others, at the end of a few weeks,—yet they ought, in all circumstances, to suck the dam till her milk becomes fit for the dairy, and afterwards to receive as much congenial nourishment as if they were allowed to grow up by sucking. A cow's milk is the natural provision for the rearing of a calf, and contains a large proportion of highly nutrient principles; and any calf which is not reared, either on the milk itself or on food similarly and equally nutritive, is certain to become an ill-thriven and ungainly adult. A common method, in districts where milk is but of moderate value, is, for about a month, to feed the calf wholly with the cow's milk from a pail,—for another month, to withhold a portion of the milk, and substitute linseed jelly or thin watergruel,—for the third month, to substitute a portion of skimmed milk for the cow's milk,—for the fourth month, to substitute skimmed milk wholly for the cow's milk,—and after the close of the fourth month, to feed wholly on the most tender kinds of herbage or other provender adapted to the general stock. But in districts where milk is highly valuable, substitutes for portions of it must be early and constantly given; and among the most approved of these are watergruel, hay-tea, linseed jelly, turnips sliced in skimmed milk, and turnips and carrots boiled with cut hay and given warm. The treatment of calves subsequent to weaning necessarily depends on the nature of the farm, or the particular kinds of food which it supplies.—The diseases to which calves are most subject will be noticed in the articles COSTIVENESS, DIARRHŒA, and NAVEL-ILL; and the particular qualities of their flesh will be noticed in the article VEAL.—*Mortimer's Husbandry*.—*Buffon's Natural History*.—*Journal of the Agricultural Society of England*.—*Papers of Mr. Aiton and Mr. Main in Quarterly Journal of Agriculture*.—*Marshall's Rural Economy of Gloucestershire*.—*Marshall's Rural Economy of Yorkshire*.—*The Farmer's Magazine*.—*Clater's Cattle Doctor*.—*Sproule's Treatise on Agriculture*.—*Youatt on Cattle*.—*Rham's Dictionary of the Farm*.—*Low's Elements of Agriculture*.—*Blaine's Veterinary*.

CALINEA. An ornamental, climbing, tropical plant, of the dillenia tribe. It is called by some botanists *Calinea scandens*, by others *Dolioscarpus calinea*, and by others *Tetracera calinea*. It is a native of Guiana, and was introduced, about twenty-five years ago, to the hothouses of Britain. It usually grows to the height of about ten feet. Its flowers are yellow; and its fruit is poisonous.

CALKINS. Thin and sharp elevations of the hinder part of horses' shoes, designed to prevent slipping in frosty weather. Calkins, as they are frequently made, strongly tend to strain the foot and damage the back sinews; and they ought to be shaped somewhat like the point of a hare's ear, and so adjusted as to maintain an equal distribution of the horse's pressure over the whole surface of the foot.

CALLA. A genus of ornamental herbaceous plants, of the order aroidæ. The Ethiopian species, *Calla Æthiopica*, was introduced to Great Britain from the Cape of Good Hope in 1731; and is now one of our best known and most popular half-tender house-plants. Kunth and some other modern botanists call it *Richardia Æthiopica*; many of the gardeners of a former period called it Ethiopian or African arum; and not a few of the popular flower-fanciers of the present day call it the Egyptian lily. Its root is fleshy, tuberous, and covered with a thin brown skin, and sends down many strong fleshy fibres. Its leaves rise in clusters, on footstalks more than a foot in length, and are eight or nine inches long, shaped like the point of an arrow, terminating in an acute backward-turned point; they are succulent, and have a shining green colour; and before the old ones decay, young ones, which advance in height during all the winter, are produced. The floral footstalk rises from among the leaves to the height of about a yard from the ground or pot; it is thick, smooth, succulent, and of a shining green; and it terminates in a single hood or spatha, with enclosed spadix and flowers. The hood or spatha is twisted at the bottom, but spreads open at the top; it is of a pure white colour, and seems, at a little distance, to possess considerable resemblance to a white lily; and, though no part whatever of a corolla or true flower, it forms a chief beauty of the plant, and is popularly regarded as the flower. The spadix or club is situated in the centre of the hood, and has a herbaceous yellow colour; and the true flowers are situated on the spadix, and are small in size and herbaceous yellow in colour, and are so closely packed together, that the stamens can scarcely be distinguished from the pistils without the aid of a microscope. The fruit consists of roundish, fleshy berries, compressed on two sides, and each containing two or three seeds; and these succeed a portion of the flowers, situated on the top of the spadix. The bloom usually appears from January till May, and can sometimes be prolonged till November. The plant is

generally treated, in every part of Britain, as decidedly tender, and requiring greenhouse heat; but, throughout the south of England, and in some other districts, it will stand all the year in the open ground, with no more attention than is usually given to fine hyacinths and anemones.—The perforated species, *Calla pertusa*—called by Linnæus *Dracontium pertusum*—is a curious, evergreen, hothouse creeper, of about six feet in length; it was introduced from the West Indies about the middle of last century; its leaves are acrid,—and, when fresh gathered, and applied to the skin, they inflame and slightly blister,—and they are used, by the natives of Demerara, as a remedy for dropsy.—The marsh species, *Calla palustris*, is a small, hardy, ornamental aquatic, half a foot in height, and a native of North America.—Two species were introduced, not many years ago, from China. The name calla is formed from a Greek word, and means “beautiful.”

CALLICARPA. A genus of ornamental shrubs, of the verbenæ tribe. The American species, *Calliocalpa Americana*, is a native of Virginia, Carolina, and other parts of America, and was introduced to Britain in 1724. It has a half-tender habit, and usually grows to the height of about six feet. Its young shoots and its leaves are covered with a kind of woolly matter, and have a hoary appearance. Its leaves are roundish, pointed, beautifully serrated, and about three inches in length; and they stand opposite by pairs, on moderate footstalks. Its flowers are produced in whorls round the twigs, at the deflexion of the leaf-stalks; they have a reddish-purple colour, and appear in June and July; and though individually small and inconspicuous, they make a fine appearance in the whorls, and combine with the leaves and the habit of growth to give the shrub a singular and very interesting appearance. Its berries are succulent; they are at first red, and then ripen to a deep purple; and their handsome appearance gives the name calliocalpa, signifying “beautiful fruit,” to the whole genus.—Eleven other species, all evergreen and very tender, have been introduced from Jamaica, China, and the East Indies; and about a dozen additional species have been scientifically described. The timber of some one of the species is much used for making charcoal, in the higher provinces of Hindostan; and its root possesses some celebrity among the natives as a remedy for certain cutaneous complaints.

CALLIOPSIS. A genus of hardy, herbaceous, ornamental plants, of the sunflower division of the composite order. It is nearly allied to *Coreopsis*, and was formerly included in that genus; and it takes the name of calliopsis, which signifies “most beautiful eye,” from the very elegant appearance of its composite flowers. The two-coloured species, *Calliopsis bicolor*—formerly *Coreopsis tinctoria*—is a hardy annual from Arkansas, introduced in 1822; it grows to the height of

nearly a yard, and carries yellow flowers from May till August; and it is one of the most showy accessions which have, for many years, been made to our stock of hardy annuals. A variety of it, *C. b. atrosanguinea*, produces dark blood-coloured flowers; and the florets of this variety are used by the natives of North America for extracting a reddish dye.—Atkinson's species is a hardy annual, with sulphur-coloured flowers, from Colombia. Drummond's species is a hardy annual, with brown-spotted reddish yellow flowers, from North America. The palmate and the roseate species are hardy perennials, with respectively yellow and red flowers, from North America.

CALLISTACHYS. A genus of ornamental Australian shrubs, of the sophora division of the leguminous order. Four species, introduced during the ten years preceding 1825, are straggling evergreens, of from three to six feet in height, carrying yellow flowers from June till August. The red-flowered species, or crimson callistachys, *C. linearis*, was introduced by seeds in 1840, and excited high expectation, but proved to have no pretensions to beauty. It is an erect shrub, with long, slender, glabrous branches, and dirty purple-coloured flowers. The long-leaved species, *C. longifolia*, was introduced about the same time as the preceding, and is fitted to make a good appearance in an open shrubbery or large collection. Its leaves are each seven inches or upwards in length, and give it a somewhat unique character; and its flowers are large, and have a yellow and brown colour, and are produced in great profusion from the extremity of all the shoots. The name callistachys signifies "a beautiful spike."

CALLISTEMMA. See CHINA-ASTER.

CALLISTEMON. A genus of ornamental, evergreen, Australian shrubs, of the myrtle tribe. It has a close affinity to the genera *metrosideros*, *encalyptus*, and *leptospermum*. About sixteen species, varying in height from five to ten feet, have been introduced; and four or five other species have been described. All the introduced species are more or less beautiful; all require greenhouse culture, and are propagable by cuttings; and two have green flowers, two greenish yellow, one pale yellow, and most of the others pink, crimson, scarlet, or other tints of red. The name callistemon alludes to the very elegant appearance of the stamina.

CALLITRICHE,—popularly *Water starwort*. A genus of annual aquatic weeds, of the haloragis tribe. Two species, the vernal and the autumnal, grow in the ditches of Great Britain, and are usually about three inches high; and a third species, the peduncled, grows in the ditches of Scotland, and is usually about a foot high.

CALLITRIS. An evergreen, ornamental, Australian tree, of the cone-bearing tribe. The cypress-shaped species, *C. cupressiformis*, was introduced to Britain about twenty years ago; and it grows to the height of about twenty feet, and

has a handsome appearance, but is too tender for general open-ground culture.

CALLUNA. See HEATH.

CALOCHORTUS. A genus of elegant, tuberous-rooted, Californian plants, of the liliaceous tribe. Two species, *C. macrocarpus* and *C. elegans*, were introduced in 1826; and three, *C. venustus*, *C. splendens*, and *C. luteus*, have been introduced since 1830. The graceful species, *C. venustus*, is now one of the most superb flowering plants in British gardens. Its stem is about 20 inches in height; and the part of it which bears the flowers is comparatively long and slender, and has, towards the middle, two lanceolate leaves. Its calyx consists of three green, lanceolate sepals; and its corolla has three ovate-oblong petals, of a beautiful white colour, with a red spot near the margin, and streaks of deep red on a yellow ground, as also a pencil of hairs, toward the base. This species presents considerable resemblance to *C. macrocarpus* and *C. splendens*, but differs from the former by the absence of a green rib on the petals, from the latter by the straightness and marking of its petals, and from both in having white for the prevailing colour of its corolla, while *C. macrocarpus* has purple, and *C. splendens* has lilac. The flowers on one stem rarely exceed two in number. The name calochortus signifies "beautiful grass."

CALODENDRON. An ornamental, evergreen, Cape-of-Good-Hope tree, of the rue tribe. It forms a genus of itself, and takes for its specific name *Capeuse*. It has the reputation of being one of the most handsome trees of South Africa; and its name signifies "the beautiful tree." Its usual height is about forty feet; its flowers have a pink colour; and its fruit resembles the chestnut, but can seldom be brought to England undamaged. This plant was introduced to Britain upwards of sixty years ago; and is propagated by cuttings.

CALOPHYLLUM. A genus of most beautiful evergreen, tropical, timber trees, of the guttiferous tribe. The fibrous-leaved species, *C. inophyllum*, usually attains a height of about ninety feet, and is one of the most elegant and graceful trees in the world. It abounds in sandy soils on the coast of Malabar, attains a very large size in the island of Balambangan, and is common in many parts of the Indian archipelago; and it was introduced to Great Britain in 1793. The inhabitants of Java and other East Indian islands plant it around their houses, for the agreeableness of its shade, the beauty of its foliage, and the fragrance of its flowers. Its timber is superior to that of most trees for every purpose which requires tortuosity and gnarledness. Its trunk, when wounded, exudes a yellowish viscid juice, which can be hardened into gum. Its leaves are shaped somewhat like those of the water lily; and are so ramified with high veins from their midrib as to seem multitudinously intersected with fibres. Its flowers have a snow-white col-

our, and a most agreeable odour; and it is held in great veneration by the Hindoos, and offered on the shrines of both Sheva and Vishnoo. Its fruit is somewhat similar in appearance to a walnut; it has a bitterish and somewhat unctuous taste; and it yields an odoriferous fixed oil, which has the reputation of being an excellent external application for rheumatisms, and is much used in Travancore for burning in lamps. Two other species have been introduced to Britain from India, and one from Bourbon; and the chief of these is noticed in the article CALABA.

CALORIC. A name given, in chemistry, to that agent which produces the phenomena of heat and combustion. It is hypothetically regarded as a subtile fluid, the particles of which repel one another, and are attracted by all other substances. It is imponderable, and, by its distribution, in various proportions, among the particles of matter, gives rise to the three general forms of gas, liquids, and solids. The particles of water, by losing caloric, have their cohesion so much increased, that they assume the solid form of ice; by adding caloric, they again become fluid; and by a still further addition, they are converted into vapour.

Caloric exists in two different states—*free or uncombined*, and *in a state of combination*. In the former condition, it creates the sensation of heat, and produces expansion in other bodies. The power which any body has of exciting the sensation of heat, and occasioning expansion, is understood by the expression of its *temperature*. This is supposed to vary with the quantity of free caloric in a given quantity of matter; a high temperature being ascribed to the presence of a large quantity of free caloric, and a low temperature to that of a small quantity. We are ignorant, however, of the extremes of temperature, and may compare it to a chain, of which a few of the middle links only are exposed to our observation, while its extremities are concealed from our view.

The *expansion of bodies* is one of the most universal effects of an increase of temperature. This increase in bulk, however, is not the same in all bodies. The same increase of temperature causes liquids to expand more than solids, and æriform bodies much more than either. On this principle are constructed the various instruments for measuring temperature; since the degree of expansion produced by caloric bears a sufficient proportion to its quantity to afford us the means of ascertaining it with tolerable accuracy. Our senses, it is obvious, are quite inadequate to afford us this information; for we compare our sensations of heat, not with any fixed or uniform standard, but with those sensations which we have had immediately previous. Hence, the same portion of water will feel warm to a hand removed from contact with snow, and cold to another hand which has been heated before the fire. To convey precise notions of temperature, therefore, we are obliged to describe the degree

of expansion produced in some one body which has been previously agreed upon as a standard of comparison. The standard most generally adopted is quicksilver, which is contained in a glass ball, terminating a long, narrow tube. This instrument is called a *thermometer*. If quicksilver, or indeed any other substance except the gases, suffered equal expansion by equal increments of the calorific power, then this instrument would be perfect; but the same increase of bulk is not effected in the same liquid or solid, at all temperatures, by adding similar quantities of heat; for bodies expand, by equal increments of caloric, more in high than in low temperatures, because the force opposing expansion is diminished by the interposition of caloric between the particles of bodies; and, therefore, when equal quantities of caloric are added in succession, the last portions meet with less resistance to their expansive force than the first. In gases, on the contrary, which are destitute of cohesion, equal increments of heat appear to be attended with equal augmentations of bulk. See the article THERMOMETER.

The *tendency to an equilibrium* is a characteristic of free caloric. Any number of different bodies, unequally heated, when exposed in an apartment to the same temperature, gradually arrive to an equality of temperature. It is in obedience to this law, that we experience the sensations of heat and cold when we touch bodies which are warmer or colder than ourselves. There exists much diversity in the rapidity with which different substances abstract caloric when in contact with a body in which it is accumulated. Common air and gases abstract it but tardily, while wood, stones, and metals acquire it more rapidly. According to their power of conducting it off under these circumstances, bodies are divided into *conductors* and *non-conductors* of caloric; and, in general, the power of conduction varies with the densities of bodies. But this tendency of caloric to an equilibrium is not established solely by the agency of intermediate bodies or communication. A part of it moves through the atmosphere, like light, in right lines, and with immeasurable velocity, and has, therefore, been called *radiant caloric*. The comparative quantities lost by radiation and by conduction may be approximated by observing what time it takes to cool any body through the same number of degrees in air and *in vacuo*. Thus Dr. Franklin imagined he had ascertained that a body, which requires five minutes to cool *in vacuo*, will cool in air, through the same number of degrees, in two minutes. Count Rumford's experiments, with a Torricellian vacuum, give the proportions of five to three. Radiant caloric passes only through transparent media, or free space. When, in its passage, its rays impinge upon the surface of a solid or a liquid substance, they are either reflected from it, and thus receive a new direction, or they lose their radiant form altogether,

and are absorbed. In the latter case, the temperature of the receiving substance is increased; in the former, it is unchanged. The nature of the surface of a body has been found to influence powerfully both the radiation and absorption of caloric. The energy of calorific emanation from a cubical tin vessel, coated with different substances, and containing warm water (as determined by the differential thermometer of Leslie), gave, with a covering of

Lampblack,	100
Isinglass,	75
Tarnished lead,	45
Polished iron,	15
Tin-plate, gold, silver, or copper,	12

Similar results were obtained simply by noting the rates of cooling in vessels of similar shapes and capacities with various surfaces. Useful lessons have been derived from these discoveries. Tea and coffee pots, which are intended to retain their heat, are made of bright and polished metals; and steam-pipes, intended to convey heat to distant apartments, are kept bright in their course, but darkened where they reach their destination. The power of different surfaces to absorb caloric was found, by coating one of the bulbs of the differential thermometer successively with different substances, and presenting it to an uniformly heated substance, to follow the same order as the radiating or projecting quality.

With regard to *combined caloric*, it has been shown that solids, during liquefaction, imbibe a quantity of caloric, which ceases to be obvious, both to our senses and to the thermometer. The same is also true of solids and liquids in their conversion into vapours or gases; a portion of caloric, which is essential to the elasticity of the new product, ceases to become apparent. Whenever this effect takes place, *cold* is said to be produced; by which we are only to understand the passage of caloric from a free to a latent form. The reverse of these phenomena has also been satisfactorily established; viz., when the density of bodies is increased, either by chemical or mechanical means, caloric is evolved. For example, a high temperature is produced by mingling cold sulphuric acid and water; metals become intensely heated by the augmentation of their density through hammering; liquids, by becoming solids, or gases by conversion into liquids, also evolve caloric. A pound of water, condensed from steam, will render 100 pounds of water 50° warmer by 11°; whereas, a pound of boiling water will produce the same rise of temperature in no more than about 13·12 pounds; and, since steam and boiling water affect the thermometer in the same manner, this effect can be produced only from the existence of a much greater quantity of caloric in the former than in the latter.

The *sources of caloric* are six; viz., the sun's rays, combustion, percussion, friction, the mixture of different substances, and electricity.

CALORIMETER. An instrument to measure

the capacity of a body for caloric, or its specific caloric. The thermometer measures merely the variations of temperature, or sensible heat. The body in the calorimeter is placed in the innermost of three concentric vessels, the two outer ones containing ice; the quantity of water produced by the cooling of the body a given number of degrees, determines its specific caloric. This instrument was invented by Lavoisier and Laplace. In the calorimeter invented by Rumford, water is used; the capacity of the body is determined by the number of degrees which the temperature of the water is raised, in cooling the body a given number of degrees.

CALOSTEMMA. A genus of very beautiful, tuberous-rooted, Australian plants, of the amaryllis tribe. The yellow-flowered and the purple-flowered species were introduced in 1819, and the white-flowered species in 1824; and the last is a plant of great elegance, blooming from February till March. Another species, called *Cunningham's*, has been more recently introduced. All are treated in the same manner as other amaryllidæ.

CALOTHAMNUS. A genus of ornamental, evergreen, Australian shrubs, of the myrtle tribe. Three species, *C. quadrifida*, *C. gracilis*, and *C. villosa*, were introduced in 1803; and one, *C. clavata*, in 1824; and all these have a height of about a yard, carry scarlet flowers from July till September, and are easily propagated from cuttings. The name *calothamnus* signifies "a beautiful rod," and alludes to the superb appearance of the branches, when covered with the scarlet flowers.

CALOTROPIS. A genus of ornamental, evergreen tropical shrubs, of the swallow-wort tribe. The giant species, *Calotropis gigantea*—called by some botanists *Æclepias gigantea*—is a native of the East Indies, and was introduced to Britain before the close of the seventeenth century. It grows to the height of about six feet, and produces white and purple flowers from July till September. Its flowers have a handsomely curved or contorted form, and give the name *calotropis*, which signifies "beautifully twisted," to the whole genus. Its bark has a somewhat pungent property; and when powdered, and mixed with margosa oil, is used in India as an external application for rheumatism. Its root is pale-coloured, bitter, and somewhat pungent; and is administered in decoction, by the practitioners of India, as a gentle stimulant in cases of fever and dyspepsia. The milky juice is used by the Tamul practitioners as a cathartic. The whole plant is said to be poisonous to sheep and goats; and, with its light-coloured, downy, succulent leaves, is used in Mysore for tanning leather. The powdered flowers are sometimes employed by the native Hindoos to adulterate safflower.—The tall species grows to about the same height as the giant species; and was introduced to Britain from Persia in 1714.

CALTHA. See MARSH MARIGOLD.

CALTROPS,—botanically *Tribulus*. A genus of trailing plants, of the bean-caper tribe. The earthy species, *Caltrops terrestris*, is a common annual weed of Italy, Spain, and the south of France; and was introduced to Britain as a curiosity toward the close of the sixteenth century. It appears, beyond doubt, to be the plant mentioned in the Georgics of Virgil, under the name of tribulus; and it takes its English name of caltrops from the resemblance of its capsules to the calcitrapa or dangerous four-spined instrument which the ancients threw in the way of enemies, to annoy and impede their cavalry. It grows among corn, and on most arable land, in its native countries; and gives great trouble to cattle, by wounding their feet with the strong prickles of its capsules. Its root is slender and fibrous; its stems are slender and hairy, and rise in groups of four or five from each root, and creep flat along the ground to the length of about fifteen or eighteen inches; its leaves are pinnate, each being composed of six pairs of narrow, hairy folioles, and they are produced from the joints of the stems; its flowers comprise five broad, obtuse, open, yellow petals, and are produced on short footstalks from the wings of the stems, and appear in June and July; and its capsules are roundish, five-cornered, and prickly, and divided into five parts, each of which has a transverse cell containing one or two seeds. The leaves of either this species or *Tribulus lanuginosus*, are employed, by some pharmacutists, as a diuretic. Five other annual species, all more or less tender, have been introduced from Georgia, Jamaica, Guinea, Thibet, and India; an evergreen, perennial species, *Tribulus cistoides*, has been introduced from South America; and about a dozen other species have been described.

CALTROPS (WATER),—botanically *Trapa*. A genus of floating aquatic plants, of the frog-bit tribe. Four genera have been introduced to Great Britain,—*T. natans* from continental Europe, *T. bicornis* from China, and *T. bispinosa* and *T. quadrispinosa* from India; and all these produce white or whitish flowers from June till August, and are cultivated for useful purposes in their native countries. "*T. natans*," says Loudon, "is a curious aquatic, with long, brown and green roots and floating leaves, with petioles inflated into a tumour, as in the marine algæ. The seed is larger than the kernel of the filbert, with two cotyledons, one large, and the other very small, and not increasing in size during the germination. Hence, Gärtner considers this plant like the Nelumbium, as in a sort of middle state between the monocotyledonæ and the dicotyledonæ. The nuts are farinaceous, and are esteemed nourishing and pectoral. The skin with the spines being removed, there is a white sweet kernel within, something like a chestnut. They are sold in the market at Venice under the name of Jesuits' nuts. They are also much eaten

in Switzerland and the south of France. Some of the canals at Versailles are covered with the plant; and Neill informs us, that the nuts are sometimes served up like chestnuts. Pliny says that the Thracians made them into bread; and Thunberg states that they (the seed of *Trapa bicornis*) are commonly put into broth in Japan. *T. bicornis* is cultivated by the Chinese in marshes; and the nuts used as food."

CALUMBA-ROOT, or **COLUMBO-ROOT**. The dried and medicinal root of the *Cocculus palmarum*, a plant of the moon-seed tribe. This plant abounds in the forests of south-eastern Africa; its root is perennial, ramose, and fusiformly tuberous; its stem is annual, round, hairy, and about the thickness of a goose-quill; its leaves stand alternately, at great distances, and on round hairy footstalks, and are five-lobed and five-nerved; and its male flowers grow in axillary, compound racemes, and comprise six small, cuneiform, fleshy petals. Only the offsets of the roots are used in commerce and medicine; and these are dug up in March, dried, and sent from Mozambique to Tranquebar, and from Tranquebar to Europe. The bark of the offsets is thick, externally olive brown, and internally bright yellow; and the part enclosed by the bark has a pale brownish colour, and a somewhat spongy texture. The roots as imported are often much worm-eaten; and the pieces freest from worm-holes, heaviest, and of the brightest colour, are the best. They have a bitter taste, and a slightly aromatic odour; and they break with a starchy fracture, and are easily pulverized. They are employed by the Africans of Mozambique as a remedy for venereal diseases; by the Chinese, as an aphrodisiac; and by the physicians of our own country, as an antiseptic and a tonic, in certain diarrhœas, in cholera, in bilious remittent fever, in phthisis, in hectic fever, in mesenteric fever, and in dyspepsia. A peculiar proximate principle, called calumbine, is obtainable from the roots; and is inodorous, extremely bitter, neither acidulous nor alkaline, and scarcely soluble in either water or alcohol. The roots of white bryony, tinged yellow with the tincture of calumba, are said to be often substituted in commerce for calumba roots.

CALVES' SNOUT. See SNAPDRAGON.

CALVING. See PARTURITION and ABORTION.

CALX. See CALCINATION.

CALYCANTHUS. A genus of ornamental shrubs, of the order Calycanthææ. This order comprises only the genera calycanthus and chimonanthus. Not more than eight or nine species of it exist in Britain; and all these are hardy, early flowering, odoriferous shrubs of North America and Japan. They differ from species of the rose and pomegranate tribes in wanting petals, and in having numerous divisions of the calyx,—from rose plants also in the form of the embryo, and from pomegranate plants in the imbrication of the calyx. The genus Calycan-

thus is noticed in the article ALLSPICE (CAROLINA).

CALYPTRA. A membranaceous veil which masks the urn-shaped capsule of the moss-plants. It is a fine integument, and has the shape of a hollow cone.

CALYPTRANTHES. A genus of ornamental, evergreen, tropical trees of the myrtle tribe. The clove-leaved species, *C. caryophyllifolia*—called by Decandolle *Syzygium caryophyllifolium*—is a native of India, and was introduced to the hothouses of Britain in 1822. It usually grows to the height of about twenty feet. Its flowers are white. Its fruit, when ripe, is of a very dark purple colour, and about the size of a large cherry; and it tastes somewhat like the sloe, but is much sweeter. Its timber is used by the Hindoos for making cots, carriage-frames, doors, windows, rafters, and handles of instruments. Its bark is astringent, and is used in decoction, by the Hindoo practitioners, as a remedy for dysentery, and as a wash for foul ulcers.—The *zuzygium* species, *C. zuzygium*, is a native of the West Indies, and is also used as a timber tree; and it was introduced to Britain about the middle of the latter half of last century. Its specific name means “yoked together,” and alludes to the paired growth or yoking together of its leaves and branches.—The *Jambolana* species, *C. Jambolana*, is a native of the Indian archipelago, and is sometimes called the Java plum-tree. It was introduced to Britain about the close of last century.—All these three species, and also another, *C. chytraculia*, which was brought from the West Indies at the same time as the *Zuzygium*, carry white flowers, attain a height of about twenty feet, and are employed for various useful purposes.—Five or six other species have been described.

CALYSTEGIA,—popularly *Bearbind*. A genus of hardy, twining, perennial plants, of the convolvulus tribe, and partly included, till of late, in the convolvulus genus. See **BINDWEED**.

CALYTHRIX. A genus of ornamental, evergreen, Australian shrubs, of the myrtle tribe. Four species, the smooth, the abundant-flowering, the pubescent, and the heath-like, were introduced to Britain during the six years preceding 1825; and all these produce white flowers; the last is about two feet high, and each of the other three is about four feet high. The name *Calythrix* means “a triple calyx.”

CALYX. The exterior whorl or envelope of a flower. It is totally wanting in many flowers, as in the hyacinth; it constitutes the whole of the phyllous or leafy portion of many flowers, as in the Carolina allspice; and it forms a conspicuous portion of the brilliant or tinted portion of some flowers, as in the fuschia. It is thick and fleshy in many plants, as in the rose; and thin and membranaceous in some, as in the common bindweed. It has, in many plants, as in the cereal grasses, the form of a glume; in others, as

in the cones of the fir and the catkins of the willow, it has the form of a scale; but, in most calyciferous plants, it has the form of a flower-cup or whorled envelope; and when, as in most instances, it consists of more phyllous pieces than one, these pieces are technically called sepals, and correspond in general form and adjustment to the petals of the corolla. When, as in the poppy, a calyx falls before the other parts of the flower, it is said to be caducous; when, as in the lime-tree, it falls along with the other parts of the flower, it is said to be deciduous; and when, as in hypericum, it does not fall till after the other parts of the flower, it is said to be persistent.

CAMBIUM. The elaborated sap of plants. The moisture imbibed by the roots and carried up to the leaves—receiving in its progress such soluble ingredients as it finds in its passage—is properly called the sap; and when this has been thoroughly elaborated in the leaf—by the evaporation of its superfluous hydrogen and oxygen, and by the fixation of carbon, and sometimes of ammonia—it becomes aliment for the plant, takes the name of cambium, and begins to descend from the leaf toward the root, or in the opposite direction to the ascent of the sap. The cambium is a limpid, viscous, mucilaginous fluid, of very compound chemical character, fitted to repair or augment such parts of the plant as are already formed, and to form such others as remain to be added; and, in the course of its descent, it visits every portion of every member of the plant, making deposits wherever they are required, and gradually diminishing in its own bulk till, at the lower extremity of the plant, it becomes wholly expended. While the ascent of the sap is free, the descent of the cambium is fixational; and while the former may be compared to the mere chyle of animals, the latter may be compared to their blood. The grand deposits or assimilations of cambium in all exogenous plants, consist of a new concentric layer of woody matter exterior to the preceding year's alburnum, and a new concentric layer of cortical matter interior to the preceding year's formation of liber; and hence, in the season of the plant's growth, or after the commencement of the vernal copious ascent of sap, the descent of the cambium is found in full flow between the wood and the bark.

As the same tide of blood simultaneously supplies bony matter to bone, muscular matter to muscle, cartilaginous matter to cartilage, corneous matter to horn, and hairy matter to hair; so the same stream of cambium supplies alburnous matter to wood, cortical matter to bark, phyllous matter to buds and leaves, and fructiferous matter to flowers and seeds. Though the descent and functions of the cambium are incomparably less obvious in endogens than in exogens; yet both their reality and their mode of action may be quite certainly and very clearly inferred from identity between the two great classes of plants, in the general forms and principles of vegetable

organization. The fact of the descent in exogens is easily and popularly demonstrated by the natural formation of a tumour or vegetable accumulation immediately above a tightly fastened ligature; and the direction of the descent, opposite to that of the sap's ascent, is demonstrated by the formation of such a tumour on the side of the ligature next the leaves of an inverted branch, such as the branch of a weeping ash or weeping willow. The cause of the descent is partly explicable on chemical principles, and receives some illustration from the endosmose and exosmose of Dutrochet; yet has been the subject of very conflicting theories and of some monstrously absurd speculations on the part of phytologists, and cannot possibly be understood without reference to the grand principle which the pride and the sneaking infidelity of a large proportion of the philosophy of the present day appears most anxious to explain away,—the principle of life. "No cause that is merely either chemical or mechanical," says the Rev. Mr. Keith—and we heartily concur with him—"will ever be found to give a satisfactory explanation of the movement in question. It may be aided by chemical or mechanical causes, but not wholly effected by them, as it is essentially a movement resulting from life, and involving the agency of the vital energies and affinities of the plants."

CAMEL. A genus of mammiferous quadrupeds, of the ruminant order, characterized by their size; the possession of incisive, canine and molar teeth; the upper lip divided; the neck long and arched; by the absence of horns, and by having one or two humps or protuberances upon the back, and naked callosities at the joints of the leg, the inferior part of the breast, &c. The inferior extremities terminate in two toes, which are not wholly covered by hoof, as they have only a small one at the extremity, and a sort of very hard, callous sole, common to both. There are six incisive and two canine teeth in the lower jaw; and, in the upper, there are two incisors in the intermaxillary bone, with one or two canine teeth on each side, which increase to a considerable size with the increasing age of the animal. The camel is the only ruminant animal which has cutting teeth in the upper jaw.

The native country of this genus is said to extend from Mauritania to China, within a zone of 900 or 1,000 miles in breadth. The common camel, having two humps, is only found in the northern part of this region, and exclusively from the ancient Bactria, now Turkestan, to China. The dromedary, or single-hump camel, is found throughout the entire length of this zone, on its southern side, as far as Africa and India. Notwithstanding this, the dromedary cannot sustain either the burning heat of the torrid, or the mild climate of the temperate zone, while the camel supports all the vicissitudes of climate with but little injury. It is highly probable that the camel has long ceased to exist in its wild or natural

state, as it has been enslaved by man from the earliest times of which we have record. Among the stock composing the wealth of the patriarch Job, we find 600 camels enumerated.

Unlike the elephant, and other animals which cease to breed in a state of captivity, the camel is as prolific as if at liberty; and vast numbers are raised and employed throughout the Oriental countries, especially in the commerce carried on between the people residing in the vicinity of the great deserts. To these people the camel serves in the place of ships, and other modes of conveyance, being especially adapted by nature for the service in which it is employed. In regions where water is exceedingly scarce, and wells or springs are several days' journey distant from each other, it would be impossible to traverse the country with the usual beasts of burthen. But the camel can abstain from drinking for seven or eight days together without injury—an important advantage, which is owing to the possession of a fifth pouch, or appendix to the stomach, destined to receive water, whenever it can be procured, and capable of retaining it unchanged for a long time. From this receptacle a portion of water can be thrown into the other stomachs or gullet when necessary, and thus avert the evils of thirst. Possessing strength and activity surpassing that of most beasts of burthen, docile, patient of hunger and thirst, and contented with small quantities of the coarsest provender, the camel is one of the most valuable gifts of Providence. There is nothing, however, in the external appearance of the animal to indicate the existence of any of its excellent qualities. In form and proportions, it is very opposite to our usual ideas of perfection and beauty. A stout body, having the back disfigured with one or two humps; limbs long, slender, and seemingly too weak to support the trunk; a long, slim, crooked neck, surmounted by a heavily-proportioned head, are all ill-suited to produce favourable impressions. Nevertheless, there is no creature more excellently adapted to its situation, nor is there one in which more of creative wisdom is displayed in the peculiarities of its organization. To the Arabs, and other wanderers of the desert, the camel is at once wealth, subsistence and protection. Their strength and fleetness render their masters the terror of enemies, and secure them from pursuit—a few hours being sufficient to place leagues of trackless desert between them and their foes. The milk of the females furnishes the Arab with a large part of his nutriment. The flesh of the young animal is one of his greatest luxuries: of the skins, he forms tents: the various sorts of hair, or wool, shed by the camel, are wrought into different fabrics; and its dried dung constitutes excellent fuel, the only kind, indeed, to be obtained throughout vast extents of country.

In order to qualify camels for great exertions, and the endurance of fatigue, the Arabs begin to

educate them at an early age. They are first taught to bear burdens, by having their limbs secured under the belly, and then a weight proportioned to their strength is put on: this is not changed for a heavier load till the animal is thought to have gained sufficient power to sustain it. Food and drink are not allowed at will, but given in small quantity, at long intervals. They are then gradually accustomed to long journeys, and an accelerated pace, until their qualities of fleetness and strength are fully brought into action. They are taught to kneel, for the purpose of receiving or removing their load. When too heavily laden, they refuse to rise; and, by loud cries, complain of the injustice. Small camels carry from 600 to 800 lbs.; the largest and strongest bear 1,000 or 1,200 lbs., from 30 to 35 miles a-day. Those which are used for speed alone are capable of travelling from 60 to 90 miles a-day. Instead of employing blows or ill treatment to increase their speed, the camel-drivers sing cheerful songs, and thus urge the animals to their best efforts. When a caravan of camels arrives at a resting or baiting-place, they kneel, and, the cords sustaining the load being untied, the bales slip down on each side. They generally sleep on their bellies, crouching between the bales they have carried: the load is, therefore, replaced with great facility. In an abundant pasture, they generally browse as much in an hour as serves them for ruminating all night, and for their support during the next day. But it is uncommon to find such pasturage, and they are contented with the coarsest fare: nettles, thistles, wormwood, and various harsh vegetables are eaten by them with avidity, and are even preferred to more delicate plants. Camels, designed exclusively for labour, are usually gelded, and females are also treated in a similar manner. They are, it is true, not so strong, nor so spirited, as un mutilated animals, but are much more manageable. During their sexual season, the males become furious and ungovernable: they refuse food, are spiteful, biting and kicking even their keepers, to whom they are, at other times, very obedient. At this time, also, a foetid secretion is effused from a glandular apparatus on the neck; the animal foams at the mouth, and a red, membranous vesicle, similar to a bladder, is extended on each side of the mouth. One male is reserved perfect for every eight females. The female receives the male in the same crouching attitude, in which she places herself to receive a load, or for the purpose of sleeping. She goes with young 12 months, and brings forth one at a birth. Her milk is very thick, abundant and rich, but of rather a strong taste. Mingled with water, it forms a very nutritive article of diet. Breeding and milk-giving camels are exempted from service, and fed as well as possible, the value of their milk being greater than that of their labour. The young camel usually sucks for 12 months; but such as are intended for speed are allowed to

suck, and exempted from restraint, for two or three years. The camel attains the full exercise of its functions within four or five, and the duration of its life is from forty to fifty years.

The humps or bunches on the back of the camel are mere accumulations of cellular substance and fat, covered by skin, and a longer hair than that of the general surface. During long journeys, in which the animals suffer severely from want of food, and become greatly emaciated, these protuberances are gradually absorbed, and no trace of them left, except that the skin is loose and flabby where they were situated. In preparing for a journey, it is necessary to guard the humps from pressure or friction by appropriate saddles, as the slightest ulceration of these parts is followed by the worst consequences: insects deposit their larvæ in the sores, and sometimes extensive and destructive mortification ensues.

The Bactrian or common camel is larger than the dromedary; the limbs are not so long in proportion to the body; the muzzle is larger and more tumid; the hair of a darker brown, and the usual gait slower. A still more striking distinction is afforded by the two humps—the dromedary having but one. This single hump of the latter occupies the middle of the back, rising gradually on all sides towards its apex, and never inclining to one side. Both species are occasionally found in collections of animals. The dromedary is more frequently seen than the camel.

During that season of the year when these gentle creatures become violent, the Turks take advantage of this change in their disposition to set on foot camel-fights—disgraceful exhibitions, indicative of the same spirit as the lion-fights of Rome, the bull-fights of Spain, the bull and badger-baitings and cock-fights of England. These fights are common at Smyrna and Aleppo. The camels of Smyrna are led out to a large plain, filled with eager crowds. The animals are muzzled to prevent their doing each other serious injury, for their bite is tremendous, always bringing the piece out. A couple, being let loose, run at each other with extreme fury. Their mode of combat is curious: they knock their heads together laterally, twist their long necks, wrestle with their fore-legs, almost like bipeds, and seem to be principally bent on throwing down their adversary.

CAMELINA,—popularly *Gold of Pleasure*. A genus of hardy, herbaceous plants, of the cruciferous family. The cultivated species, *Camelina sativa*—called by Linnæus *Myagrum sativum*—is an annual weed of the cultivated fields of Britain; yet it does not grow with us in a truly wild state, but is generally introduced among imported flax-seed or by other artificial means. Its stem is usually about twelve or eighteen inches high; its leaves are lanceolate, and nearly entire; its flower is pale yellow, and appears from May till July; its pods are pear-shaped, scarcely half the length of their footstalks, and divided by two large and

two smaller ribs; and its seeds are ovate, and un-margined, with flat and incumbent cotyledons. It is an oleiferous plant; grows better on light and shallow soils than any other cruciferous oil-plant; and rushes so rapidly to maturity as to yield two crops a-year in the south of Europe. The oil produced by it is nearly inodorous, and gives a brighter flame, with less smoke, than the oil of rape or of mustard. The stems also are fibrous, tough, hard, and durable, and are used for thatching, for temporary buildings, and for making brooms, sack-cloth, sail-cloth, and packing-paper. This plant is cultivated in Holland, Belgium, Germany, the north of France, and some adjacent districts, and is found very serviceable for sowing in June or early in July, after other and more valuable crops have failed; and, though hitherto neglected in Britain, would no doubt perfectly succeed with us, under any ordinary cultivation; and it possesses the advantage of being unassailed by the aphides, which often make such havoc upon rape and other brassica crops. In Belgium, it is sown after a failure of rape, colza, or any similar crop; the ground for it is ploughed and harrowed; the seed is sown at the rate of two pounds per acre, in mixture with ashes or fine sand, to promote its equal distribution; and a sufficient covering is effected by the bush-harrow or traineau. Two well-established varieties, the smooth and the pilose, are also cultivated; and either one of these or some other, under the name of *Le Cameline Majeur*, of stronger growth and greater oleiferousness than the normal kind, has recently obtained much favour among the farmers of the north of France. Five other species of *Camelina*,—three annual and two perennial and evergreen—have been introduced to Britain; but they possess little or no interest. See OIL-CAKE.

CAMELLIA. A genus of superbly beautiful, evergreen shrubs, forming the type of the natural order *Camelliacæ*. This order comprises only the genera *camellia* and *thea*; but it ought also to comprise *eurya*, *lettsumia*, *gordonia*, *stuartia*, and the other seven genera which are usually assigned to the order *Ternstroemiaceæ*. The two species of tea plant, green and bohea, are so closely allied to *camellia* that they were formerly included in the genus, just as they are now included in the order; and they unite with the true *camellias* to render this the most celebrated group of plants in modern times,—the tea-plants for the delicious beverage afforded by their dried leaves, and the true *camellias* for the surpassing elegance of their form and foliage, and the exquisite delicacy, shape, and tinting of their flowers.

The name *Camellia* was given to the genus, in honour of George Joseph Kamel or *Camellus*, a jesuit who made some contribution to the systematic botany of the Indian archipelago. The common species, *Camellia Japonica*, is a native of China and Japan, and was introduced to Great Britain from the former of these countries in 1739. It appears to have been long cultivated

and highly admired by both the Chinese and the Japanese; it figures, in common with *hibiscus* and *chrysanthemum*, in a large proportion of Chinese paintings; it abounds in the gardens and groves of both China and Japan, not only as a beautiful shrub, but as a superb and soaring tree; and it has been so carefully and scientifically managed by the Chinese, as to exist among them in a great number of perfectly distinct and permanent varieties. When this magnificent plant was introduced to Britain, impassioned admiration of its handsome form, its shining deep green foliage, and its splendid white and red flowers, was immediately and extensively excited, a demand for specimens of it at almost any price was created, and a search for new varieties of it, at even exorbitant costs, was provoked and encouraged. Not fewer than between thirty and forty distinct varieties were imported from China, without any abatement in the popular passion for the plant being experienced; hybrids and British seedlings began at length to be produced, with little other effect than to increase the plant's popularity; and though hundreds upon hundreds of British, French, Italian, Belgian, Dutch, and German hybrids have been eventually brought out, till the whole subject of the *camellia* has become a labyrinth, and fully two-thirds of the known kinds are unworthy of cultivation, the passion for the plant has only become correspondingly extended and refined, without being in any degree diluted or vulgarized.

The common *camellia*, in by far the greater number of its varieties, attains in Britain a height of about ten feet, blooms from February till May, and is cultivated solely for the sake of its ornamental appearance.—The *Sasanqua camellia*, *C. Sasanqua*, was introduced from China in 1811, usually grows to the height of about four feet, carries a white flower from February till November, and is exceedingly inferior to the common *camellia* in ornamental character. Yet it somewhat readily goes to seed, and has been very generally employed by European growers as the female parent for producing new varieties. Hybrid seedlings between the *Sasanqua* and the common *camellia* may be brought to flower in four or five years; and all such as produce inferior flowers can be used as excellent stocks for the inarching or grafting of some of the noblest existing varieties. Both the blossoms and the buds of the *Sasanqua* appear to be gathered by the Chinese for the composition of superior kinds of teas; and its leaves also are employed by them in mixture with the boheas,—rather, however, in adulteration than in improvement. Three varieties of the *Sasanqua* were introduced from China previous to the year 1825; the double red, with pink flowers; the double white, with white flowers; and the semidouble white, a very beautiful plant, with white flowers.—The oleiferous species, *C. oleifera*, was introduced from China in 1819, and usually grows to the height of about

four feet. It is generally cultivated, in its native country, for the sake of its oleiferous seeds; it succeeds best in a red sandy soil, frequently attaining a height of eight feet; and it carries a profusion of white flowers from May till July. Its seeds, as well as those of all the other species, are bruised, stewed, and pressed, in order to yield a fine oil; and this oil is highly valued by the Chinese, and very generally used in their domestic economy.—The Kissi camellia, *C. Kissi*, was introduced from Nepaul in 1823; it usually attains a height of about ten feet; it carries white flowers from May till July; and though much inferior to the common camellia, is a very handsome plant.—The eurya-like species, *C. euryoides*, was introduced from China in 1824; it usually attains a height of about four feet; it carries a white flower in May and June; and it belongs to the same grade of beauty as the oleiferous species.—The reticulated camellia, *C. reticulata*, was introduced from China in 1824; it usually grows to the height of about six feet; and it has a superb appearance, and produces red flowers from April till June.

The varieties of *Camellia Japonica* introduced from China, as noticed in the last edition of London's *Hortus Britannicus*, are the single red, *rubra*; the single white, *alba*; the semidouble red, *semiduplex*; the double red, *rubro-plena*; Middlemist's flesh-colour, *carnea*; the myrtle-leaved, *myrtifolia*; Loddiges' dark red, *atrorubens*; the Waratah or anemone-flowered, *anemoniflora*;* the variegated Waratah, *versicolor*; the pœony-flowered, *pœoniæflora*; the double striped, *variegata*; the Kew blush pompon, *pomponia*; Hume's blush or the flavescent, *flavescens*; the double white, *alba plena*; Welbank's, *Welbankii*; Lady Long's involute, *involuta*; the variable white Waratah, *variabilis*; the hexangular, *hexangularis*; the carnation-flowered Waratah, *dianthiflora*; the pale yellow, *luteo-alba*; the fringed white, *fimbriata*; the thick-nerved, *crassinervis*; the expanded, *expansa*; the shell-flowered, *conchiflora*; L. Campbell's red-stemmed, *rubricaulis*; the long-leaved, *longifolia*; the aucuba-leaved, *aucubæfolia*; the scarlet, *coccinea*; the great-flowered, *grandiflora*; the dwarf, *nana*; the incarnate, *incarnata*; the blush Waratah, *blanda*; Ross's, *Rossii*; the spatulate, *spatulata*; the straw-coloured, *straminea*; Rawes's showy, *speciosa*; the imbricated, *imbricata*; the white semidouble, *alba semiduplex*; Reeves's, *Reevesiana*; the rose-like-flowered, *rosea*; Parks's, *Parksii*; and Sabini's, *Sabiniana*. British seedlings and hybrids are vastly too numerous, and in many instances far

* The name Waratah is given to several of the varieties, in allusion to the resemblance of the central petals to those of the Waratah plant of Australia, *Telopea speciosissima*; and the double Waratah, the double white Waratah, and the double striped Waratah, are at once free-growers, free-flowerers, and very splendid varieties; while the single Waratah produces seeds, from which some of the best camellia grafting stocks are obtained.

too inferior, to admit of enumeration; but a few of the earliest and best are Aiton's large single red, the hollyhock-flowered, the coral-flowered, the splendid, the flowery, the white anemone-flowered, the striped Waratah, the rose of the world, the single red spotted, Gray's spotted, Press's eclipse, Press's single red, Colvill's, Sweets', Donckelaer's, the compact-flowered, Knight's, Elphinstone's, Woods's, Lady Wilton's, and Press's double rose; and the first six of these possess the celebrity of having been the earliest group of British camellias, and were figured, in a quarto volume by Messrs. Chandler and Buckingham of London, under the title of *Camellia Britannica*.

An ingenious classification of camellias, made by the Abbe Berlese, distributes all the known varieties into one-coloured flowering plants and two-coloured flowering plants, and each of these divisions into a first scale which commences with pure white, passes through rose-colour, cherry-colour, and amaranth, and ends with crimson, and into a second scale which commences with carnation yellow or dirty white, passes through flesh-colour and orange-red, and ends with dark crimson. One-coloured flowers of both scales exhibit, in each instance, only one colour, as white, rose, cherry, flesh-colour, amaranth, orange-red, crimson, and dark crimson; but two-coloured flowers, have, in each case, a ground colour, varied with some other colour of its own scale, as a white ground varied by a rose-colour, a rose-ground varied by a cherry-colour, or a cherry-ground varied by a white. Of one-coloured flowers of the first scale, the Abbe Berlese enumerates, as pure white, *C. alba simplex*, *alba plena*, *amabilis*, *axillaris*, *anemoniflora*, *alba plena*, and twenty-two others; as of a clear rose-colour, *C. Aitonii*, *amplissima*, *Apollina*, *dahliaeflora*, and twenty-two others; as of a clear cherry-red colour, *C. aucubæfolia*, *Amherstia*, *amœna*, *augusta*, and ninety-two others; and as of a deep cherry red colour, *C. Alexandriana*, *althæiflora*, *atroviolacea*, and fifty-one others. Of one-coloured flowers of the second scale, he enumerates, as of carnation colour, *C. alba lutescens*, *carnea*, *incarnata*, and Kew blush; and as of orange-red colour, more or less deep, *C. anemoniflora*, *sinensis*, *atrorubens*, *augusta rubra aurantiaca*, and a considerable number of others. Of two-coloured flowers of the first scale, he enumerates, as having a white ground, striped or blotched with rose, *C. Banksii*, *dianthiflora striata plena*, *delicatissima*, *elegantissima*, *gloria mundi*, *imperialis*, and ten others; as having a rose-ground, streaked or dotted, with cherry-red, *C. Colvillii vera*, Gray's Venus, Gray's eclipse, *splendida*, and eight others; and as having a cherry ground, more or less deep, varied with white, *C. Aglae*, *Adonidea*, *dianthiflora*, and thirteen others. Of two-coloured flowers of the second scale, he names, as having a yellowish flesh-coloured ground, streaked with white, *C. Sweetii vera*; and as having an orange-red

ground, either clear or dark, streaked or blotched with white, *C. Chandleri striata*, *Cunninghamii*, *mutabilis*, *imbricata tricolor*, and four others.

A few of the best camellias may be named and briefly characterized, for selection from among the bewildering multitude of varieties; *C. imbricata*, beautifully imbricated to its centre, and red in colour, but sometimes faintly streaked with white; *imbricata alba*, like the preceding, but white in colour; *anemoniflora*, red, outer petals large, flat, and five or six in number, and the inner petals small, numerous, and resembling those of a double red anemone; *Chandlerii*, red, often blotched with white, similar in form to *anemoniflora*, but with fewer inner petals; *reticulata*, reddish purple, very large, five or six inches in diameter, and not unlike *pœonia moutan*; *fimbriata*, white, fringed in the edges, imbricated to the centre, and very beautiful in form; *pleno-alba*, similar in form to *fimbriata*, but without fringing in the edges of the petals; *candidissima*, a very delicate white, and beautifully imbricated; *Hume's blush*, the outer petals round and recurved, the inner petals small, pointed, and gradually diminishing in size, and the blossoms so profuse as often to amount to ten in one group; *Press's eclipse*, white ground, spotted with pale red carnation colour, and very double, but not so regular as *pleno-alba*; *Gray's invincible*, delicate blush, striped and slightly spotted with pale rose, similar in tinting to a rose-flake carnation, and similar in form to *Press's eclipse*; *pomponia*, delicate blush, the outer petals large and generally arranged in two rows, and the inner petals smaller, irregular, and rising in the centre of the flower; *elegans*, rosy pink, the outer petals large, the general form similar to *pomponia*, and the whole flower very large and fine; *eximia*, deep rose, imbricated, very double, the petals notched at the ends, and the whole flower large and fine; and *Donckelaer's*, pink with white blotches, the petals round, and the whole flower large and much admired.

A mixture of equal parts of loam and peat earth forms the best soil for camellias; but when the loam is peculiarly light and sandy, the proportion of peat earth ought to be less than one-half. A mixture of loam, sand, and leaf-mould is also used by some of the cultivators in the neighbourhood of London. The ingredients ought to be thoroughly mixed, and passed through a coarse sieve; and the portion of peat and loam which will not pass the sieve ought to be used for filling the bottom of the pots, and there promoting a free drainage. The general shifting of plants from smaller pots to larger, ought to be effected when the young growth has hardened, and the blossom-buds for the next year begin to be discernible at the extremity of the shoots; and all plants, after being shifted, or about the end of June, may either be removed into the open air, or retained in the greenhouse, according to the season at which they are wanted to

flower. Plants removed to the open air, should be placed in an airy situation, with a northerly exposure, and so as to receive the direct rays of the sun only in the mornings and evenings; for if exposed to the south, or to a play of sunshine during the hotter parts of the day, they will so rapidly mature their flower-buds as to produce dwarfish or otherwise inferior flowers; and, at the commencement of the heavy autumnal rains, or about the middle or end of September, they must be taken back to the greenhouse. Such plants as are kept constantly in the greenhouse ought, during summer and early autumn, to enjoy a very free circulation of fresh air, and to be occasionally sprinkled with water over the whole of their foliage; and all plants whatever, while in the greenhouse, or while under dry open air, must enjoy constant attention to moderate and regular watering. "It is a principle in horticulture," remarks the Abbe Berlese, "that ever-green exotics under glass, being continually more or less in a growing state, require a good deal of water throughout the year, even in winter; and this is particularly the case with the camellia. It must be abundantly supplied with water from the time its buds begin to swell, previously to flowering, and till the buds on the young shoots have attained their full size; and, throughout the remaining part of the year, the ground must be kept in an equable degree of moisture, as either too much or too little humidity is as injurious to camellias as it would be to heaths. During the months of May and June, the camellias may be watered overhead by a syringe; and the floor of the house should always be kept watered at this season, in order to maintain a humid atmosphere." If watering be not copious and regular during the maturation of the flowering, the bloom-buds, instead of expanding into flower, will certainly fall off; and if moderate regular watering be not given during even the least active periods of growth, the whole plant will either perish or suffer serious damage to its health and energy. As the roots are apt to become so matted in the pots as to intercept the filtration of water, examination should be made that the moisture of a watering descends to the ball of soil, and does not expend itself on the mere web of radical fibres, and care should be exercised that all plants in any degree matted be shifted from smaller pots to larger at least once a-year; and as constant and sometimes copious watering may be supposed to diminish or destroy the fertility of the small portion of soil allotted to any one plant, care ought to be exercised, at the annual repotting, to take away as much of the old ball of earth as can be removed without inflicting injury on the roots.

The camellia may be regarded as a hardy greenhouse plant, of habits very similar to the myrtle, requiring only a slight protection in severe weather, and thriving and flowering far better when kept just above the freezing-point

in winter, than when kept in any higher temperature; yet, during the period of its forming its chief annual increase of bulk and substance, an increase in the heat around it is very decidedly advantageous. A temperature of from 43° to 45° Fahrenheit, during every night from the beginning of October till the end of March, maintained with the utmost possible regularity or equality, is regarded by the Abbe Berlese as essential to the preservation of the flower-buds, and as the grand remedy for the evil so much complained of in both France and Britain,—the decaying and dropping off of a large proportion of the buds. The Abbe ascribes the immaturation of decaying flower-buds to the circumstance of the vegetating power of the plant being, at this period, active only in the flower-buds and not throughout its other organs; and he states that, in the course of forty-eight hours, during a fall of temperature from 59° to 25°, he observed the flower-buds to drop off from one hundred fine camellias. Four varieties which expand their buds with great difficulty are *C. Dorsetti*, *Woodsii*, *Chandleri*, and *florida*; but even these, if kept through winter in an uniform temperature immediately above the freezing-point, especially when they are aided by a thinning out of their buds, will expand their blossoms as fully as the least shy and most robust varieties.—The aphid, the ant, the coccus, and other insects which infest camellias may be destroyed by tobacco-smoke, and removed with a sponge and water; and worms which get into the pots and infest the roots, may be destroyed with a decoction of tobacco.

All the fine varieties of camellia may be propagated by inarching or grafting and budding either on stocks raised from seeds of the kinds already incidentally noticed, or on stocks raised from cuttings of the common single red variety. Cuttings of this variety strike root much more readily than those of the double-flowering varieties; they are taken in July or August, or as soon as the young shoots are sufficiently ripe at the base; they are cut smoothly over with a sharp knife at a joint, and divested of one or two leaves at the bottom; and they are then firmly planted about two inches deep, in pots filled in their lower half with the soil most suitable for growing camellias, and in their upper half with fine white sand. The would-be plants are well-watered, plunged in a tan-bed or other slight hotbed, and kept closely shaded for three or four months; when sufficiently rooted to bear removal, they are potted singly in small pots, well drained, and filled with camellia compost containing a small addition of sand; afterwards, they are sprinkled with water, and placed in a close frame or pit till they begin to root afresh; and finally, they are exposed by degrees to the air, and begun to be treated in a somewhat similar manner to the older plants. In the succeeding year, many of the stocks thus raised from

cuttings will be ready for inarching or budding; and in the second year, all the remainder will be ready. The best time for inarching is early in spring, just before the plants begin to grow; and for budding, as soon as the new wood is sufficiently ripened. Camellias inarched in March are fit to be separated by the end of August; and plants inarched in May are fit to be separated in October. The methods of grafting the camellia practised in France and Belgium, are inarching, approach-cutting, cleft-grafting, and side-grafting. Seeds of camellia should be sown as soon as they are ripe, in heath soil, and placed in a mild and humid atmosphere; and though the seedlings from them most frequently do not come up till the second year, they can very generally, if treated with ordinary care, be brought to flower at the end of five or six years.—*Berlese's Monograph of the Genus Camellia*.—*The Gardener's Chronicle*.—*The Gardener's Gazette*.—*The Gardener's Magazine*.—*The Magazine of Domestic Economy*.—*Loudon's Hortus Britannicus*.—*Loudon's Encyclopædia of Plants*.

CAMERARIA. A genus of ornamental, evergreen, tropical trees and shrubs, of the dog's-bane tribe. The broad-leaved species, *C. latifolia*—sometimes popularly called bastard manchineel—grows wild, in great plenty, in Havannah, and was introduced thence to Britain during the former half of last century. Its stem usually rises to the height of about thirty feet, and divides into several branches; its leaves are roundish pointed, much veined, and opposite; and its flowers are produced in loose clusters at the ends of the branches, have a yellowish-white colour, and appear in August. Both this species, and two others which have been introduced, are handsomely-flowering plants, and are easily propagated from cuttings. Three described species have not yet been introduced.

CAMPANULA. See **BELLFLOWER**.

CAMPINE. Purified oil of turpentine, employed for burning in lamps peculiarly constructed for it. Being a liquid rich in carbon, it is necessary to bring a large quantity of air in contact with it in a given time in order to prevent the flame from smoking and to produce great brilliancy. This is generally effected by not allowing the wick scarcely to rise above the containing cylinders, by the use of longer chimneys, by using an outer cylinder or cone which throws the outer current of air obliquely against the flame, and by the use of a moveable button of the same diameter as the wick, and directly above it, by which the inner current of air is directed against the flame. The two counter currents of air supply sufficient oxygen in a given time to produce a white light of great intensity, and the amount of flame is regulated by raising or depressing the button, so that if it be depressed very low, the flame is extinguished or burns blue.

CAMPHOR. A white, resinous production, of

peculiar and powerful smell, not unlike that of rosemary, extracted from two or three kinds of trees of the bay tribe, that grow in the islands of the East Indies and China. Of these the principal is the *Laurus camphora* of Linnæus, or *Cinnamomum camphora* of more modern botanists. It is of considerable height, much branched, and has spear-shaped leaves, with nerves, of a pale-yellowish-green colour on the upper side, and bluish-green beneath. The flowers are small, white, and stand on stalks which issue from the junction of the leaves and branches. Camphor is found in every part of the trees; in the interstices of the perpendicular fibres, and in the veins of the wood, in the crevices and knots, in the pith, and in the roots, which afford by far the greatest abundance. The method of extracting it consists in distilling with water, in large iron pots, which serve as the body of the still, with earthen heads fitted to them, stuffed with straw, and provided with receivers. Most of the camphor becomes condensed in the solid form among the straw, and part comes over with the water. Its sublimation is performed in low, flat-bottomed glass-vessels, placed in sand, and the camphor becomes concrete, in a pure state, against the upper part, whence it is afterwards separated with a knife, after breaking the glass. Numerous other vegetables are found to yield camphor by distillation. Among them are thyme, rosemary, sage, elecampane, anemone, and pusanilla. A smell of camphor is disengaged when the volatile oil of fennel is treated with acids; and a small quantity of camphor may be obtained from oil of turpentine by simple distillation, at a very gentle heat.

Camphor has a bitterish, aromatic taste, is unctuous to the touch, and possesses a degree of toughness which prevents it from being pulverized with facility, unless a few drops of alcohol be added, when it is easily reduced to a powder. It floats on water, and is exceedingly volatile, being gradually dissipated in vapour if kept in open vessels. At 288° Fahr. it enters into fusion, and boils at 400° Fahr. It is insoluble in water, but is dissolved freely by alcohol, from which it is immediately precipitated, in milky clouds, on the addition of water. It is likewise soluble in the fixed and volatile oils, and in strong acetic acid. Sulphuric acid decomposes camphor, converting it into a substance like artificial tannin. With nitric acid, it yields a peculiar acid, called *camphoric acid*. This acid combines with alkalis, and forms peculiar salts, called *camphorates*. They have not hitherto been applied to any useful purpose.

In a crude state, camphor is formed into irregular lumps, of a yellowish-grey colour, somewhat resembling nitre or bay-salt. It is imported into Europe in canisters, and the refining of it was long kept a secret by the Venetians. The Dutch have since performed this work; and large quantities of camphor are now refined by some

of the English and American chemists. For carpenters' work the wood of the camphor-tree is much used. It is light and durable, and, in consequence of long retaining its aromatic smell, is not liable to be injured by insects. Plants of the camphor and cinnamon trees were captured by Admiral Rodney in 1782, and afterwards carried to Jamaica, and propagated there. The camphor-tree which grows very abundantly in the western parts of Japan, is a different species from that found in the islands of Sumatra and Borneo, with which we are principally acquainted.

Camphor was formerly in great repute as a medicine, but at present its virtues are less highly rated. It is a cordial and stimulant of a decidedly heating character, and is, therefore, improper in all fevers, unless the system is very low and weak. In such cases, if combined with nitre and other cooling articles, it is sometimes an excellent diaphoretic. But, in fevers in general, it is an article rather to be avoided.

As an internal medicine, camphor has been frequently employed, in doses of from 5 to 20 grains, with much advantage, to procure sleep in mania, and to counteract gangrene. In large doses, it acts as a poison. Dissolved in acetic acid, with some essential oils, it forms the aromatic vinegar. It promotes the solution of copal; and, from the circumstance that its effluvia are very noxious to insects, it is much used to defend subjects of natural history from their ravages. In cattle medicine, it is used externally in liniments for palsy and garget; and in horse medicine, it is used internally with opium for locked jaw, and externally as a discutient and an anodyne, for chronic tumours, refractory sprains, severe bruises, and old callus. An abominable spurious substitute for it is sometimes palmed upon the unwary, manufactured by passing chlorine gas through oil of turpentine.

CAMPHOROSMA. A small genus of plants, of the goosefoot tribe. The Montpellier species, *C. Monspeliaca*, is a curious tuberous-rooted, apetalous greenhouse plant, of about twenty inches in height, of warm and somewhat pungent taste, and abounding in a volatile oily salt. It has an odour somewhat like camphor-vapour; and hence gives the name of *Camphorosma*, signifying "camphor-smell," to the whole genus. Two uninteresting annual species were not long ago introduced from Continental Europe.

CAMPION,—botanically *Cucubalus*. A vile and mischievous perennial weed, of the carnation tribe. It forms a genus of itself; and takes for its specific name *baccifer* or berry-bearing. It grows naturally among the hedges of England, has a height of about twenty inches, and carries a white flower in June and July. Its berries are said by Miller to be as poisonous as those of deadly nightshade.

CAMPION (CORN). See CORN-COCKLE.

CAMPION (ROSE).—botanically *Agrostemma*. A genus of hardy herbaceous plants, of the clove-

tree tribe. It has recently been mixed up, by some botanists, with the *lychnis* genus; but must long, perhaps always, continue to be distinct in the estimation of seedsmen and cultivators. The common species, *A. coronaria*, has long been a hardy perennial ornament of our gardens, and was introduced from Italy before the close of the 16th century. It grows to the height of two or three feet, and carries a bright red flower from June till September. Two well-established varieties of it, *alba* and *plena*, carry respectively white and double flowers; but the latter variety is only about half as tall as the normal plant.—The umbelled species or Flower-of-Jove, *A. Flos-Jovis*, is a perennial, red-flowering plant, of about twenty inches in height, from Germany. The smooth-leaved species or Rose-of-Heaven, *A. coeli-rosa*, is an annual plant, of about a foot in height, and with flesh-coloured flowers, from the Levant. The githago or corn-campion species is the well-known weed CORN-CKLE.

CANADA-BALSAM. A balsam or turpentine obtained from the Balm of Gilead fir, *Abies balsamea*. It is light, yellowish, transparent, of an agreeable terebinthic odour, a slightly bitter and acrid taste, flowing like thin honey when fresh, but solidifying by time. Bonastre's analysis of it gave, essential oil 18·6; resin easily soluble in alcohol 40·0; resin difficultly soluble 33·4; elastic resin 4·0; bitter extractive and salts 4·0.

CANADA RICE,—botanically *Zizania*. A small genus of aquatic grasses, of the *olyra* tribe. The water species, *Zizania aquatica*, abounds in almost all the shallow streams of north-western America, and affords, in its prolific produce of mild farinaceous seeds, abundant food for vast flocks of large water-fowl, and a considerable proportion of the ordinary food of the wandering tribes of Indians. It was introduced to Great Britain in 1790, and has been acclimated, not only in Middlesex, but in Ross-shire; and it has been regarded by some economists as probably a valuable addition to the number of our bread-corn grasses. It is an annual, and flowers from July till September, and usually attains a height of about six feet. See the article ACCLIMATATION OF PLANTS. The millet-like species, *Z. miliacea*, was introduced to Britain in 1816, and the floating species in 1824; and both of these are annuals, natives of North America, growing to the height of about four feet, flowering in July and August, and producing farinaceous seeds of important economical value. Two other species have been scientifically described.

CANAL. A canal, in navigation, is an artificial channel for transportation by water. The first inquiry in the project of such a work, accordingly, relates to the amount of transportation that will be accommodated by the route proposed, at some given rate of tolls: for the quantity will be in some degree influenced by that rate. If the project be a mere speculation, or investment of capi-

tal by individuals for the sake of income, its expediency will be determined by the nett amount of annual tolls it will probably yield; which ought, in this view of the matter, to be equal to the ordinary rate of interest. But the general utility or public expediency of a project of this sort is not determined wholly by this mode of calculation; for, in this view, we must look at the indirect advantages, such as the increased value of lands on the borders of the canal, the increased profits of other works connected with or affected by the one proposed; as in the case of the smaller branches of internal navigation in England, many of which are not very productive investments, but doubtless contribute to the large income of the great lines of transportation between the principal towns, as London and Liverpool, by increasing the amount of goods that pass along those lines. To determine the general public utility of one of these smaller branches, therefore, we must estimate not only the increased value which it gives to coal-mines, stone quarries, forests, &c., on its borders, but also its effects in enhancing the value of other canals. But a work of this sort may be, on the whole, of public utility, although an absolute income, in consequence of the investment, can nowhere be traced, but only a reduction of the cost of some article of general use, by means of a diminution of the labour, the number of days' or hours' work, necessary to furnish the article, at any place. Thus the proprietors of the duke of Bridgewater's canal are under obligation to supply the inhabitants of Manchester with coals at the rate of 4d. for 140 lbs., which is a great benefit to the inhabitants of that town. This is one of the advantages of this work, which should be taken into the account in estimating its public utility. Another beneficial consequence of any great improvement of this description, as well as those of other kinds, often is to promote some species of arts: for instance, a canal may promote agriculture, horticulture, &c., by irrigation or opening a market. In determining on any canal project, then, as well as in estimating its utility, these various circumstances are to be taken into consideration. The motives, whether of public utility or private emolument, or a union of them both, being sufficient to induce to the undertaking, the next things to be considered are, the obtaining of an adequate supply of water, the particular route to be taken, and the mode of construction.

CANARINA. A small genus of ornamental, perennial-rooted, herbaceous plants, of the bellflower family. The bellflower and the smoothed species, *C. campanula* and *C. levigata*, are natives of the Canaries, and were introduced to Britain, the former towards the end of the 17th century, and the latter in the year 1825; and both grow to the height of about three feet, and carry orange-coloured flowers from the end of autumn till the middle of spring. Sweet, speaking of the bellflower species, says, "It is very desirable as it

flowers in autumn and winter, when few other plants are in bloom. After flowering, the stem lies down, and the roots continue dormant all the summer, when they need but little water. When they begin to grow, they had better be placed in the stove, as they will not flower so abundantly in the greenhouse. A light loamy soil suits them best, or a mixture of loam and peat; and they are readily increased by dividing the roots, or from cuttings planted in the same kind of soil under a handglass."

CANARY-GRASS,—botanically *Phalaris*. A genus of grasses, of the agrostis division, and constituting itself the type of a subdivision. The common species, *Phalaris canariensis*, grows wild in some uncultivated spots in Britain; and is cultivated, for various purposes, in some districts of England, and in some other countries. Its culm has usually a height of about two feet; its panicle is so contracted as to have the form of an oval spike; its glume is thin, chaffy, and entire at the point, and has a large keel and two green stripes along each side; and its seed is smooth and shining, whitish in colour, and difficult of separation from the glume. The shining appearance of the seed is alluded to in the botanical name *phalaris*, which signifies "brilliant;" and the form, colour, and economical uses of the seed are well known to almost every young person in Britain, as the chief food on which caged domestic singing-birds subsist. The plant is cultivated in the Isle of Thanet and some other English districts, for the supply of our shops with bird-seed; and in the Canary Islands, for the grinding of its seeds into flour, and the baking of this into bread, for the use of the human population. It requires a rich and thoroughly pulverized soil; it takes a longer time to arrive at maturity than either oats or barley; and it is regarded, in many of the finest districts of the south of England, as a considerably precarious crop; and yet it forms a rather favourite subject of cultivation with many of the farmers of the Isle of Thanet, and of the district around Sandwich.

It is usually sown after summer-fallow, bean-stubble, or clover-ley. If the land be not very rich, a coat of thoroughly rotten farm-yard manure is, in many instances, ploughed into it; and whether manured or not, the land is well ploughed in autumn, and completely pulverized at the earliest possible period in late winter or early spring. The seed is sown either broadcast or in drills about a foot asunder, at the rate of about five gallons per acre; and, if sown broadcast, it is well harrowed in. When the blade appears, and the rows are distinct, a first hoeing is given with the Dutch hoe; and in May or June, a second hoeing is given with the common hoe. The crop is later in ripening than any other cereal crop; and is cut with an instrument called a "twibble" and a "hink," which lays it into masses, called wads, each equal to about half a sheaf. The wads are left long on the ground, in order to receive suf-

ficiency of moisture to crack or loosen the glumes, and permit the grain to be thrashed out; and they are from time to time turned, in order to enjoy the full action of both moisture and sunshine. The cut crop thus remains in the field till December; and yet neither vegetates nor sustains any kind of damage. The usual produce is from three to five quarters per acre. But in the Woburn experiments, on a rich clayey loam, above a retentive subsoil, the quantity of green produce of the whole crop per acre was 54,450 lbs.; of dry produce, 17,696½ lbs.; and of nutritive matter, 1,876 lbs. The straw has little value compared to that of other grain crops; yet forms good fodder for horses. The crop has been tried in a green state for the feeding of cattle; but, irrespective of the comparatively high cost of seed, it has not proved equal in abundance and nutritiousness to the forage-grasses in general cultivation.

The reed-like species, *Phalaris arundinacea*—called by Trinius *Degraxis arundinacea*, and by Sowerby and Smith *Arundo colorata*—abounds in ditches, pools, and the margins of rivers, in many parts of Britain, and usually grows to the height of from three to six feet, flowers in July, and is perennial-rooted. Its culms are upright, and nearly covered with long, broad, tapering, sheathing, dark-green leaves; its panicle is spreading, crowded, and generally of a dark reddish colour; and its seed is long, smooth, and shining. It has been found to yield, per acre, on a black sandy loam incumbent on clay, 27,225 lbs. of green produce, 12,251½ lbs. of dry produce, and 1,701½ lbs. of nutritive matter; and, on stiff adhesive clay, 34,031 lbs. of green produce, 17,015½ lbs. of dry produce, and 2,127 lbs. of nutritive matter. Cattle generally refuse it in its growing or green state, yet readily eat it when made into hay, cut into chaff, and mixed with other food; and it yields so very large a bulk of hay, with a fair proportion of nutritive matter, as probably to be deserving a far higher degree of attention from farmers than it has yet received.—A variegated variety of this species, *P. a. variegata*, is well-known as an ornamental garden grass.

The Cape species, *Phalaris capensis*, is an annual, and was introduced from the Cape of Good Hope in 1804. It grows to the height of about a foot, flowers in June and July, and is rather earlier than the common species, but has a more slender culm, a smaller and more tapering panicle, and considerably smaller and darker-coloured seeds.—The paradoxical species, *Phalaris paradoxica*, is an annual, and was introduced from the Levant in the latter part of the 17th century. Its culm is nine or ten inches high; its panicle is cylindrical and spike-like; some of its florets are barren; its glume has a tooth on the keel; its seed is small, and similar to that of the Cape species; and its entire economical value is greatly inferior to that of the common species.—The changed and the appendiculate species, *P. com-*

mutata and *P. appendiculata*, are recently introduced ornamental annuals; six other annual species, and two perennial species, introduced from foreign countries, possess little or no interest; several species, formerly ranked as canary-grasses, have been assigned to four allied genera; and about ten or a dozen other species have been scientifically described.—*Sinclair's Hortus Gramineus Woburnensis*.—*Lawson's Agriculturist's Manual*.—*The Museum Rusticum*.—*Marshall's Rural Economy of the Southern Counties*.—*Knowledge Society's British Husbandry*.—*Low's Agriculture*.—*Loudon's Hortus Britannicus*.

CANAVALIA. A genus of climbing and trailing plants, of the kidney-bean division of the leguminous order. Three species have been introduced to the hothouses of Britain from India, and one from Jamaica; and four other species have been scientifically described. Most of the species were formerly included in the genus *Dolichos*; and several share in the Indian celebrity of that genus for furnishing grateful esculents. The sword-podded species, in particular, *Canavalia gladiata*, is held in very high esteem in India for its culinary legumes. The species called *Canavalia bonariensis*, is a very beautiful climbing plant; and, on account of its flowering during the whole summer, it is an important accession to the greenhouse or the conservatory. Its stem is woody, sarmentose, and very long; its leaves are ternate, smooth, and shining; and its flowers have a most beautiful reddish purple colour, and are produced in axillary racemes. Plants of this species can very easily be propagated by layers.

CANCER. A virulent and gangrenous tumour, in any part of the body of an animal. Cancer in the eye completely changes the visual organism into a decomposing fleshy substance, which either abounds with irrepressible fungous growths, or ulcerates and wastes away; and this horrible disease occasionally attacks cattle, but does not admit of cure or even of amelioration. Cancers in other parts of the body of cattle are not uncommon; and, happily, they may be either averted or alleviated. Tumours, which of themselves give little or no pain, appear on the cheeks, under the eyelids, in the channel between the jaws, on other parts of either the face or its adjuncts, or in the immediate vicinity of joints; and these tumours are frequently the precursors of cancer, or the niduses in which it is formed. In some instances, they are small, broad-based, and firmly attached; and in others, they become very large, and either hang loose, or have a comparatively slight attachment; but the former sort are far more likely to break than the latter, and often give origin to the most virulent cancers. When these tumours break, they discharge a thin and excoriating fluid, and form fungous wounds, whose "proud flesh" will grow again and again, almost as quickly as it can be removed. The tumours may, in most instances, be so eradicated with the knife, that no cancerous ulcer or fungous wound will

follow; but when they break, the ulcers which they originate are generally incurable, yet can be alleviated by the use of iodine and the hydriodate of potash. See the article **IODINE**. Cancer is said to have received its name from the resemblance of the tumid veins of very bad cases of it to the claws of a crab.—*Clater's Cattle Doctor*.—*Knowledge Society's Treatise on Cattle*.—*Turton's Medical Glossary*.

CANDLE. An article so well known in domestic economy as to render any description of it entirely superfluous. The term is obviously derived from the Latin *candela*; and that from *candere*, to burn. Candles are by no means a modern invention, though lamps seem to have been chiefly used by the ancients for domestic purposes: mention is made of something like candles, both of tallow and wax, and not unfrequently of pitch, as having been in use amongst them. The wicks were originally small cords; afterwards, the papyrus and the pith of rushes were used. But the ancients seem at no time to have been able to produce an article in any degree to be compared with the candles of modern times.

Candles may be manufactured from a great variety of substances, but those chiefly employed are tallow and wax.

Tallow candles.—Candles made from tallow are either dipped or moulded. The first kind are the candles in common use, and have been long known in commerce; the second sort is a more recent invention, and claimed by a Parisian.

The tallow employed by the candlemaker consists chiefly of ox and sheep tallow. That obtained from the hog is rarely used, on account of the bad smell which it has in burning, as well as a thick black smoke; but chiefly on account of its being easily melted,—a quality of the very worst kind. Sheep-tallow, with a portion of the best ox-tallow, is set aside for the moulded candles. Candles made principally from sheep-tallow have a better gloss and firmer texture than those which are manufactured wholly from ox-tallow. The quality of the candles depends as much upon the care and cleanness with which the tallow is collected by the butcher, as upon the species of animal from which it is derived; but, even where the greatest care is employed, parts of the tallow must necessarily be mixed with impurities which cannot afterwards be completely separated from it. The extensive manufacturer will therefore not only carefully select the tallow for the finer candles, and for those of common use, but will separate from his stock the inferior pieces of tallow, and such as are mixed with impurities, in order to dispose of them to the inferior dealer.

After the tallow is properly sorted, it is put into a wooden vessel, and cut into small pieces preparatory to the first melting, which, in the technical language of the workmen, is called

rendering. Much depends upon this operation being performed as soon as possible after the tallow comes from the hands of the butcher. If the tallow is allowed to remain for several days exposed to the action of the air—which must often happen to the inferior dealer, who receives his tallow in small quantities, and at considerable intervals—part of it will corrupt and infallibly injure the whole mass; but if the tallow is *rendered* soon after it comes from the slaughter-house, it may be kept for months or years, and even improved by keeping, provided the temperature is moderate. The object of this operation, is to separate from the tallow the skin and fleshy parts which always adhere to it, and expel, by evaporation, the aqueous particles. With this view, the tallow, after being cut into small pieces, is thrown into a large boiler, and heat gradually applied. As the tallow melts, new portions are added; and particular care is taken to stir it frequently, in order to prevent the more solid parts from adhering to the bottom of the vessel. After boiling a considerable time, the more solid parts collect at the surface in the form of a cake, which is called the *crackling*; part of the liquids have been driven off by the boiling, and the remainder subsides to the bottom after the boiling ceases. The cake is then put into a press, and great pressure applied, in order to extract from it every particle of tallow: it is afterwards set aside to be sold for food to dogs and other animals. The liquid tallow is taken from the boiler and put into an adjoining vessel, by making it pass through an iron sieve, by which means any of the solid parts which have not united with the cake are separated from the liquid mass. Still, however, many foreign substances will remain blended with it; and in order to purify it still more, the tallow is put into another vessel, and a certain quantity of water mixed with it. The water being specifically heavier than the tallow, sinks to the bottom, and carries along with it any impurities which may have escaped the operation of the sieve. After standing a sufficient time for the impurities to settle, this tallow is transferred, by means of tinned iron buckets, into tubs of a moderate size, and allowed to congeal. It is then taken out of the tub in a solid state, and piled up for future use. In transferring the tallow from the large vessel into the tubs, care must be taken not to agitate it too much, lest the slimy matter connected at the bottom rise and mix with it again. To prevent this, the workmen usually cease emptying the vessel when they come within an inch or more of the slimy matter, which they readily discover by its muddy white colour. The residue of the tallow is allowed to remain in the vessel during the night, and in the morning it is taken out in a solid state, and set apart to be re-melted with new tallow.

After having sorted and purified the tallow in

the manner above described, the candlemaker proceeds to cut and arrange the wicks, which, with the exception of such as are intended for the coarser dipped candles—are made of fine spun cotton. The cotton usually employed is chiefly obtained from Turkey, and comes into the hands of the candlemaker in the form of skeins. Four or more of these skeins, according to the intended thickness of the wick, are wound-off at once into bottoms or clews, and afterwards cut, by means of a very simple machine, into pieces of a particular length, corresponding to the size of the intended candle. Before putting the wicks into the moulds, or placing them on the sticks for dipping, it is usual to dress them, by slipping them between the fingers and thumb, with the view of laying the threads smooth, and removing knots and such foreign substances as might injure the candles. Even after this dressing, it is difficult, in consequence of the shrinking of the cotton, to keep the wicks, when placed upon the broaches, completely separate from each other. To obviate this inconvenience, it is usual to take a great number of wicks into the hand, and dip them into melted tallow. After rubbing them between the palms of the hand, and allowing the tallow which adheres to harden, they may be arranged with ease upon the broaches.

We shall now describe the process of *dipping* and *moulding*. The dipping-room is furnished with three important pieces of apparatus, viz. a boiler for melting the tallow,—the dipping-mould,—and a large wheel for supporting the broaches. The first part of the process must obviously consist in remelting the tallow which had been previously *rendered* and set aside in a solid state. The expense and trouble of remelting is sometimes saved by commencing the operation of dipping immediately after the rendering, or before the tallow cools; but the saving thus effected is not to be compared with the advantage gained by employing tallow of different ages. We are told, that a mixture of tallow recently rendered, with some of ten or twelve months standing, is the best for making either dipped or moulded candles. The melted tallow, after being carefully skimmed, is transferred into the dipping-mould, by means of ladles or small buckets, in such quantities as may be required. The dipping-mould is a box of an oblong form, lined with lead, of about three feet in length, two in breadth, and two feet in depth, erected on a frame at such a height as to suit the convenience of the workman who sits on a chair beside it. To the extremities of the box are sometimes attached two leaves or boards, to receive the droppings of the candles as they rise successively from the dipping-mould. This additional piece of apparatus may, however, be dispensed with, provided the workman is careful to raise the candles slowly from the liquid mass, or to allow the suspended drops again to touch

the surface of the tallow. To prevent the tallow in the dipping-mould from freezing, or becoming less liquid than the process requires, it is usual, in some manufactories, to place a chafing-dish below the dipping-mould, for the purpose of keeping the tallow at the proper temperature. When the tallow is kept very hot in the adjoining boiler, and when the process of dipping proceeds with such rapidity as to occasion a constant renewal of the tallow in the dipping-mould, it will be found that a chafing-dish is quite unnecessary, except in very cold weather. At each supply, however, of new tallow, the workman ought to be careful to remove from the sides of the vessel whatever may have hardened in the interval. Things being thus arranged, the workman, according to the first plan of dipping, takes into his hands three sticks or broaches, on which have previously been suspended a certain number of wicks corresponding to the size of the candles intended to be made; and, keeping them at an equal distance from each other by means of his second and third fingers, he immerses the wicks two or three times in the liquid tallow, and then hangs the rods upon a rack to cool. The same operation is repeated several times, till the candles acquire the proper thickness. With the view of facilitating the process of dipping, and in order to diminish the fatigue of the workmen, various contrivances are in use, on the description of which we need not here enter.

We shall next describe the process of *moulding*, which, if possible, is even less complicated in its details than that of dipping. The moulds are made of some metallic substance—usually pewter—and consist of two parts. The shaft, or great body of the mould, is a hollow cylinder, finely polished in the inside, and open at both extremities. The top of the mould is a small metallic cup, having a moulding within side, and a hole to admit the wick. The two parts are soldered together; and when united have the shape of a moulded candle. A third piece, called *the foot*, is sometimes added: it is a kind of small funnel, through which the liquid tallow runs into the mould, and being screwed to the opposite extremity of the shaft, is removable at pleasure. Twelve or sixteen of these moulds, according to their size, are fixed in a frame, which bears a great resemblance to a wooden stool, the upper surface of which forms a kind of trough. The top of the moulds points downwards; and the other extremity, which is open, is inserted into the bottom of the trough or top of the stool, and made quite level with its upper surface. In order to introduce the wicks into the mould, the workman lays the frame upon its side on an adjoining table, and holding in his left hand a quantity of wicks, previously cut to the proper length, introduces into the mould a long wire with a hooked point. As soon as the hook of the wire appears through the hole in the top of the mould, he attaches to it the looped end of

the wick, and immediately drawing back the wire, carries the wick along with it. In this manner each mould in succession is furnished with a wick. Another workman follows, and passes a small wire through the loop of each wick. This wire is intended to keep the wick stretched, and to prevent it from falling back into the mould upon the frame being placed in the proper position for filling. The frame is now handed to the person that fills the moulds, who previously arranges the small wires in such a manner that each wick may be exactly in the middle of the mould. The moulds are filled by running tallow into the trough from a cistern furnished with a cock, and which is regularly supplied with tallow of the proper temperature from an adjoining boiler. When the workman observes that the moulds are nearly half-filled, he turns the cock, and laying hold of that portion of the wick which hangs out of the mould, pulls it tight, and thus prevents any curling of the wick which might injure the candles. He then opens the cock, and completes the process of filling. The frame is now set aside to cool; and when the tallow has acquired a proper consistence—which the workman easily discovers by a snapping noise emitted by the candles upon pressing his thumb against the bottom of the moulds—he first withdraws the small wires which kept the wicks tense, and then scraping off the loose tallow from the top of the frame with a small wooden spade, he introduces a bodkin into the loop of the wick, and thus draws each candle in succession from its mould. The candles are now laid upon a table for the inspection of the exciseman, and afterwards removed to the storehouse. Previous to storing them up, some candlemakers bleach their candles, by exposing them to the air and dews for several days. This additional labour can be necessary only when the dealer is obliged to have early sales; for if the candles are kept for some months—as they ought to be, before they are brought to market—they become sufficiently whitened by age.

Besides the common dipped and moulded candles, a kind of candle intended to burn during the night without being snuffed, is also made of tallow. These candles are usually called *rush-lights*, from the wick being made of split rushes.

Wax candles.—Next to tallow, the substance most employed in the manufacture of candles is wax. Wax candles are made either by the hand or with a ladle. In the former case, the wax being kept soft in hot water, is applied bit by bit to the wick, which is hung from a hook in the wall; in the latter, the wicks are hung round an iron circle, placed immediately over a large copper tinned bason full of melted wax, which is poured upon their tops, one after another, by means of a large ladle. When the candles have, by either process, acquired the proper size, they are taken from the hooks and rolled upon a table, usually

of walnut-tree, with a long square instrument of box smooth at the bottom. As the candles must be rolled one by one, in order to preserve their warmth, and keep the wax soft, those made with the ladle are laid, previous to the rolling, in a feather-bed folded in two, at convenient distances from one another. The same precaution is not so necessary with the candles made by the hand, as they may be rolled just as they are formed.

A candle differs from a lamp, chiefly in the circumstance, that the tallow, or wax, is melted gradually and in small quantities, and is retained in a cup formed by the solid part of the candle. As this cup must obviously be of very small dimensions, it is of the last consequence that the quantity of matter melted never exceed the power of the wick to absorb it, otherwise the candles will gutter. The size of the wick, therefore, must always be proportioned to the fusibility of the substance employed; the more fusible substance obviously requiring the larger wick. Of the two substances commonly used, wax is the least fusible. Tallow melts at 92° of Fahrenheit, spermaceti at 133° , and bleached wax at 155° . The flame of wax is less brilliant than that of tallow, which is supposed to be owing to the wax being already combined with a portion of oxygen. This disadvantage, however, is more than compensated by its being less fusible; by which means a smaller wick may be used, which not only affords the advantage of a clear perfect flame, but, in consequence of its flexibility, it naturally falls to one side, and, by thus coming in contact with the air, is burnt to ashes. The wick of the tallow candle being much larger, preserves its position in the centre of the flame, which is less perfect, from its internal part not being completely exposed to the action of the air. As the burning proceeds, the wick lengthens, and, consequently, the distance between its top and the point of the flame diminishes; from which it follows, that the oil which issues from the extremity of the wick, having a smaller portion of flame to pass through, will be less perfectly burnt, and will pass off partly in smoke. The wick soon rises above the top of the flame; but, owing to its size, and the quantity of oil which it contains, it is not converted into ashes, and dissipated, as in the case of the wax candle. On the contrary, the half decomposed oil is converted into a kind of coal, or soot, which gradually accumulates upon the top of the wick, and assumes the appearance of a fungus. In order, therefore, that a tallow candle may burn with any degree of clearness, constant snuffing is requisite.

From the above statement, it appears, that the chief difficulty in improving the burning of the tallow candles, arises from the great fusibility of the tallow. Several attempts have been made to remove, or at least to lessen, the evil, but none of them have completely succeeded. Various methods of purifying the tallow, and

rendering it more firm and compact, are in use. In all these processes, alum seems to be the chief agent, to which is sometimes added nitre and sal ammoniac. In order to give tallow the appearance of wax, quicklime is used in purifying it, and sometimes vinegar. The tallow thus prepared, when mixed with an equal portion of wax, makes very beautiful candles. Several attempts have been made to deprive tallow of the bad smell, but none of them have completely succeeded. A decoction of rosemary, sage, laurel, and wild mint, has been used; and the powder of charcoal has been suggested. The former, however, it is likely, only conceals the odour without removing it, and, at any rate, could scarcely be employed on a great scale. The wax extracted from the fruit of the wax-tree, when mixed with a portion of common wax, or, what is better, with tallow, makes excellent candles, which diffuse an agreeable odour in burning. Candles have also been made of the butter of the cocoa-nut, and of an oil extracted from the brain of the whale, which, after being exposed to the air, soon acquires a considerable degree of consistence. Candles made of the latter material are covered with a slight varnish; those made from the cocoa burn with a clear steady flame, and last much longer than tallow candles. *Sterine* candles are moulded from the harder or fatty portions of tallow, excluding the oily particles; *sperm* candles, from purified spermaceti. Both these kinds of candles requiring a higher temperature to soften them, are well adapted to tropical climates. Tallow candles were long subject to an excise duty of 1d. per pound, and those made of wax and spermaceti to a duty of $3\frac{1}{2}$ d. per pound. This duty was repealed on the 1st of January 1832. In 1830 its nett produce was £482,413, levied on 115,586,192 lbs. of tallow, and 1,265,113 lbs. of wax and spermaceti candles.

CANDLEBERRY MYRTLE,—botanically *Myrica*. A genus of ornamental shrubs, of the am-entaceous order. The sweet gale, or British species, *Myrica Gale*, grows wild on the bogs of England, and on the boggy moors and heathy mountains of Wales and Scotland; it is raised in public nurseries, and allowed a place in private shrubberies; and it makes a conspicuous and very diversified figure in popular adaptations to economical purposes. Numerous stems of it rise from one root-stool, attain a height of about four feet, and ramify each into several slender branches. Its leaves are stiff and lanceolate; they measure about an inch and a half in length, and about half an inch in extreme breadth, or across the middle; they are smooth on the surface, and a little serrated at their points; and they have a light yellowish green colour, a bitter taste, and a grateful fragrance similar to that of the leaves of myrtle. The catkins are produced from the side of the branches, and appear in May; and the berries are small and clustered, and ripen in autumn. The leaves were formerly used by some

persons instead of tea, but were found to be hurtful to the brain. "From this use of them," says Miller, "a learned physician, a few years since, wrote a treatise to prove this to be the true tea!" The leaves were also used in former times by the northern natives, and perhaps are still used by some of the Scottish Highlanders, as a substitute for hops; but, in order to prevent their mischievous effect upon the head, they require to be very long boiled. The leaves are likewise used by the Scottish Highlanders as a garnish to their dishes, as a perfume to their wardrobes, as a preventive of the depredations of moths, and, in infusion, as an anthelmintic to children. The plant is eaten by horses and goats, but refused by cows and sheep. Branches of it are laid by the Welsh and Scotch beneath their beds, to kill fleas and moths; a strong decoction of it is used by the Swedes to kill bugs and all such vermin as infest the human body; and shrubs of it, gathered in autumn, are used by the Welsh and the Swedes for giving a yellow dye to wool. An essential oil is obtainable from the plant by distillation, and may be supposed to possess, in a concentrated form, the greater portion of its economical virtues; and a waxy substance is obtainable, by decoction, from its catkins, and is used to tan calf-skins, and might, if plentiful enough, be employed to make candles, and fully to vindicate the plant's popular name of candleberry myrtle.

The common or wax-bearing species, *Myrica cerifera*, grows naturally on bogs and swamps in North America, and was introduced thence to Britain at the end of the seventeenth century. Its strong shrubby stems rise to the height of about eight feet; its leaves are stiff, lanceolate, and about three inches long, and one inch broad; its catkins are about an inch in length, and appear in May and June; and its berries are small, round, and covered with a mealy-looking powder. This species is known in North America as the tallow-shrub or candleberry tree; and was long regarded as of very high economical importance. Its leaves and other parts can be used for the same purposes as those of the sweet gale; its root has a powerful effect in subduing toothache; and its berries readily yield a large supply of waxy matter, fit for making candles and plasters, and for the manufacture of an agreeably fragrant kind of soap. Candles were formerly made in great quantities from this substance, and were held in high esteem, but are now found to be too expensive; and plasters and soap, made from it, are still in use.—Two other hardy but evergreen species have been introduced from North America; nine greenhouse, evergreen species have been introduced from various countries,—principally the Cape of Good Hope; and ten or eleven other species have been described.

CANDOLLEA. A genus of ornamental shrubs, of the dillenia tribe. The wedge-shaped species, the oldest known, was brought from Australia in

1824; Brown's and Hugel's species were brought from the same country in 1837; and other species have since been discovered and introduced. All the species have a close relationship to those of the genera *hibbertia* and *hemistemma*. The wedge-shaped species carries yellow flowers, and grows to the height of seven or eight feet. The pedunculate species are very ornamental. Cunningham's species is a low and thoroughly glabrous shrub; its branches are smooth, shining, reddish, slender, flexuose, and disposed to climb; its leaves are alternate, linear, and about an inch and a half in length; its flowering-branches are axillary, and very short, and have the appearance of small bunches of axillary leaves; and each peduncle rises from amidst the leafy bunch of a flowering branch, and bears on its summit a single, yellow, five-petalled flower.

CANDYTUFT,—botanically *Iberis*. A genus of ornamental plants, of the cruciferous family. Several of the species are natives of Spain; and they borrow from the ancient name of that country, Iberia, the generic designation *Iberis*. The umbellate species, *I. umbellata*, was introduced to Britain from Candia before the close of the seventeenth century; and it took the name of candytuft from its native country, and afterwards communicated this name to its co-species. This is one of the best known hardy annuals in all sorts of gardens, from the humblest to the most aristocratic; it grows to the height of about a foot, and carries compact and beautiful umbels of lightish purple flowers; and it thrives in any soil, and with almost any treatment, and admits of a long succession of sowings, and of consequent flowerings.—The bitter species, *Iberis amara*, is a native, though rather scarce, annual of the chalky fields of England. Its stem is slightly shrubby; its leaves are smooth and nauseously bitter; and its flowers are produced in oblong clusters, and have a brilliantly white colour.—The sweet-scented and the pinnate-leaved species, are fragrant annuals from the south of Europe. The violet and two other species are ornamental annuals; five species are biennials; and ten or eleven species—among others, the fragrant ever-flowering species from Sicily—are dwarfish, ornamental undershrubs.

CANE-BRAKE. See **ARUNDINARIA**.

CANELLA. A small genus of evergreen, ornamental, tropical trees, of the guttiferous tribe. The white species, *C. alba*—well known in medicine for its bark—grows wild in the inland woods of the West Indies, and was introduced to Britain during the former half of last century. Its stem is straight, and from ten to fifty feet high; its branches are erect, unspreading, and produced from only the upper extremity of the stem; its leaves are spatulate, entire, dark-green, nerveless, and similar in smoothness, thickness, glossiness, and odour to those of the laurel; and its flowers grow in clusters upon divided foot-stalks, are small and of a scarlet or whitish-pur-

ple colour, and emit a powerful aromatic fragrance. The inner bark of the branches is freed from the cuticle, dried in the shade, and sent to Britain as a drug; some of it flat and nearly a quarter of an inch in thickness, and some quilled like the bark of cassia or cinnamon, but considerably thicker than the latter, and suggesting, from its reed-like appearance, the generic name of *canella*, or "little-cane." The dried bark has a slightly bitter and extremely warm and pungent taste; and, when broken, emits an aromatic odour similar to that of a mixture of cloves and cinnamon. It is stimulating and gently tonic, and forms an useful ingredient in medicines for dyspepsia and a tonic gout, and a powerful corrective of the griping properties of resinous cathartics. It has a place in the list of cattle medicines, but is scarcely so useful, in that list, as a mixture of gentian and ginger. The ancient natives of the Antilles constantly used it in both their meat and their drink; and many of the negroes were long fond of it as a condiment.—The laurel-leaved species, *C. laurifolia*, has very generally been confounded with the white species; but it does not grow to so great a height.

CANKER. A disease in the mouth of young cattle. When the teething of a calf is unusually troublesome, pimples appear on the gums and on the membrane of the mouth, and, in many instances, grow into one another, ulcerate, occasion topical swelling, impair or destroy appetite, and excite general fever. Epsom salts ought to be administered, and diluted tincture of myrrh or solution of alum ought to be locally applied; and, if the accompanying fever be severe, a fever drink ought to be administered.

CANKER. A virulent disease in the feet of horses. It is quite local; and either arises from accidental causes, such as high calkins or filthy litter, or is an accompaniment or a consequence of grease, thrush, or some other similar disease. It most frequently attacks the hind feet, and is generally difficult and sometimes impossible to be cured. The frog is the first part attacked, and becomes soft and fungous, discharging a scrofulous matter, of a peculiarly offensive smell. The horny frog eventually disappears; and the sensible frog, instead of secreting horn, forms a substance somewhat resembling shreds of leather. The disease soon extends to the sole and other parts of the foot; and, when it reaches the coffin bone, it may, in almost every instance, be regarded as incurable. "Canker," says Blaine, "has been likened to scirrhus and to cancer; and, in some of its external characters, it somewhat resembles fungus hæmatodes; but a true parity cannot be maintained with any of these. It can hardly be said to have any constitutional origin; it is essentially local, seldom if ever spontaneous. It appears oftener in hot weather than cold, and is more frequently seen in crowded and filthy stables than in well-regulated ones. It is now unknown in the army; and, as we may sup-

pose, were the same preventive causes applied, would be almost equally unknown elsewhere. The disease originates in various ways. One source, as supposed, but supposed only, is the high heels or calkins of the heavy draught-horse, which remove the frog from that pressure which seems so necessary to its healthy state. The state of wet and filth these horses stand in in some stables is a more likely source. Moisture applied to the frogs is a most active agent; it disorganizes the frog itself, and increases the growth of the horn of the heels, which aggravates the evil, as high heels and a full healthy frog are seldom seen together. Another common origin is neglected thrush, in which the suppuration, extending beyond the sensitive frog, inflames the vascular sole, and extensive ulceration succeeds. Virulent and neglected grease will often occasion it; and it is no uncommon circumstance for quittor to degenerate into canker." The proper treatment of this disease is to remove all exciting causes, to reduce the fungous growths, and to restore the healthy secretions. A perfectly clean stable and perfectly clean keeping are indispensable; the sedulous avoiding of all unctuous applications, and especially the preventing of all access of moisture, whether directly or through the surgical dressings, are essential; the removal of the fungous growths must be effected by caustics, by the knife, or by both; and the restoration of the healthy secretive function may be promoted by a long and patient series of topical applications. But the cure of canker is always both a nice and a very tedious process; and it ought never, if possible, to be attempted except under the immediate direction of a veterinary surgeon.

CANKER, or CANKER. A disease in fruit-trees, elms, larches, and other trees. It chiefly corrupts the juices, corrodes the substance, and destroys the vitality of the young shoots and branches of fruit-trees; and it has long been known and deplored as a most formidable enemy of orchards. Its symptoms vary considerably in trees of the same species, and very widely in trees of different genera. In some instances of its attack, a black speck appears upon the epidermis of a tree, assumes the character of an erosion, and gradually eats away the organism, till the branch becomes utterly enfeebled, and readily breaks; in other instances, a scrophulous-looking ring surrounds the branch, and eats its way inward till it reaches the pith; and in others, a black and thread-like line of disease originates in the pith itself, and exerts, in the direction of the exterior, a killing power upon all the branch's functions. The first of these, however, is the most common commencing symptom of the disease; and this is usually accompanied with an enlargement of the vessels of the bark; but in some instances is dry, and in others sanious. In trees, such as those of the *pyrus* genus, whose natural sap contains a considerable quantity of free acid, it is generally

dry; but in trees, such as the elms, whose natural sap abounds in astringent or mucilaginous constituents, it is usually attended with a sanious discharge. George W. Johnson, Esq., proposes that the dry forms of the disease should be called *Gangræna sicca*, and that the discharging forms of it should be called ulcer or *Gangræna saniosa*.

The swelling or enlargement of the vessels of the bark, which constitutes so conspicuous a symptom of some of the ordinary kinds of canker, invariably and prominently attends it in the apple-tree, invariably but less prominently attends it in the pear-tree, frequently but not always attends it in the elm and the oak, and very seldom, if ever, attends it in the peach. "The swelling," says G. W. Johnson, "is soon communicated to the wood, which, if laid open to view, on its first appearance, by the removal of the bark, exhibits no marks of disease beyond the mere unnatural enlargement. In the course of a few years, less in number in proportion to the advanced age of the tree, and the unfavourable circumstances under which it is vegetating, the swelling is greatly increased in size, and the alburnum has become extensively dead; the superincumbent bark cracks, rises in discoloured scales, and decays even more rapidly than the wood beneath. If the caries is upon a moderately-sized branch, the decay soon completely encircles it, extending through the whole alburnum and bark. The circulation of the sap being thus entirely prevented, all the parts above the disease of necessity perish." The first appearance of the disease in the peach is so very slight, that an unexperienced observer of it would suppose it to be of no consequence. Small brown circular spots constitute the whole of this appearance, and may easily be cut out with the knife, so as to let the subsequent vegetation be as vigorous as if they had never existed. But let the spots be forgotten for a few days; and, when the observer returns to examine them, they will be found to have spread far and eroded deeply,—perhaps to have surrounded the shoot, eaten down to its core, stopped its circulation, and extinguished its life.

Canker was never observed by Mr. G. W. Johnson—one of the best writers on the subject—in any tree of the pine tribe; and yet—though in a somewhat different form than in fruit-trees—it has been found to damage and devastate entire plantations of larch. In its first or latent stage in a larch-tree, small diseased-looking spots may be observed on removing the bark; and if the tree be otherwise healthy, and its foliage luxuriant, the sap-vessels of the affected part will be found charged with inert and morbidly-secreted rosin. In a more advanced stage, the outer rind of the bark is slightly discoloured, the rosin exudes to the exterior of the bark, and the cortical layers become blistered and die. When the disease is virulent, it encircles the branches, stops the circulation, and occasions the death of all the portions of the branches exterior to it from the

stem; and, in some instances, it makes such frightful havoc upon all the branches of a tree, as to leave nothing but their stumps and the stem; or eventually, it attacks the very stem itself, and extinguishes the organism of the whole plant. In its milder forms, however, it does not encircle the stem or branches, but permits the sap to arise and the cambium to ascend upon part of the circumference; and in these instances, the trees attacked by it, if otherwise healthy, continue to have a vigorous growth. "In some plantations," says Mr. Drummond of Perth, "the disease may be seen on the main stem of individual trees, which continue to make rapid progress, and appear to sustain no injury unless at the part affected. But in some places, such is now its malignancy that the whole bark becomes diseased, and many young plantations totally destroyed."

Sir Humphrey Davy found depositions of carbonate of lime on the edges of canker on apple-trees; yet he made only very general observations, and rather hastily inferred from them that the disease is occasioned by an excess of alkaline or earthy matter in the cambium. Depositions made by a sanious canker can hardly guide a judicious diagnosis of any instance of dry canker; and, especially, depositions by a running canker in trees of a mucilaginous nature, cannot, with any propriety, be treated as indications of the nature of canker in trees with acidulous juices. Yet the copious sanies discharged by canker in the elm is—on its own account, if not in connexion with the disease at large—a subject of very considerable interest; and this was examined, with chemical precision, by Vauquelin. This liquid is nearly as transparent as water; in some instances, very slightly coloured, and in others, of a blackish brown colour, but in all, having a saline and acrid taste. It deposits, on the sides of the ulcer, a soft substance, which is insoluble in water. The bark over which it flows acquires an appearance like that of chalk, becoming white, frangible, crystalline, alkaline, and effervescent with acids; and its crystals, when examined through a magnifier, are seen to be rhomboids and four sided prisms. When the liquid is discharged in large quantities, the alkaline deposit assumes a somewhat stalactitic form; and when it has a dark colour, the bark becomes blackish, and appears as if coated with varnish. The dark-coloured, slimy deposit is found, by analysis, to consist of carbonate of potash and ulmin,—the latter a proximate principle peculiar to the elm, yet very nearly identical with the humus which forms so large and important a constituent of fertile soil; and the white, crystalline, chalky-looking matter is found to consist of 60·5 per cent. of vegetable matter, 34·2 of carbonate of potash, 5·0 of carbonate of lime, and 0·3 of carbonate of magnesia.

The causes assigned for canker have been very various and conflicting, and the subject of much

controversy, both friendly and acrimonious; and even exciting causes, but especially aggravating causes, are probably several in number, diversified in their mode of action, and much controlled by the peculiarities of climate, soil, culture, species, and age. Some phytologists think that canker is occasioned wholly by coldness and churlishness of climate; others regard it as a topical disease in the parts immediately affected, brought on by some bruise or other injury, and exasperated by an unhealthy sap, consequent upon unfavourableness of situation, soil, and culture; others view it as an effect of the lodgment of minute, parasitic fungi, growing from spores either taken up from the soil through the spongioles, or received from diffusion through the atmosphere into cracks or wounds in the bark; and others think that it is a disease in the constitution or whole organic system of trees, that it springs from a vitiated and peccant state of all the juices, and that it will again and again break out, independently of any external injury or agency, so long as the juices continue to be unaltered.

The notion that coldness of climate is the sole cause of canker, does not include the influence of bruises, insects, bad culture, and unfavourable soil, but merely regards these as ancillary or aggravating causes, unable of themselves to develop it with any considerable virulence, yet increasing the power of the one grand cause; and, thus modified, it was propounded, six years ago, by Mr. Pearson of Kinlet in the *Gardener's Gazette* and the *Quarterly Journal of Agriculture*, and afterwards defended, in the former of these periodicals, throughout a long controversy. "Formerly," says Mr. Pearson, "it appeared singular to me, when I read the practice of various authors on the cure of canker in fruit-trees, that they always blamed the subsoil; yet the subsoil of every situation varies as much as the superincumbent soil. One blames cold, clayey rotch, while another blames sandy rotch; a third does the same with clay, while a fourth blames the sand; and the prevention of the roots penetrating these various subsoils seems to be the panacea for all the cankering evils of these various situations; but is it not singular enough, that the cankering matter should be found in every subsoil in the kingdom, or wherever a gardener chooses to stick in his spade? The mystery is solved at once when we come to consider the withering and penetrating power of the weather on spongy, unripened wood. Canker proceeds also from cuts, bruises, and the attacks of insects; but all these produce insignificant effects compared with those of the atmosphere. It may appear difficult to reconcile the above theory with the canker in the larch. I say nay; for as there are times when the atmosphere hangs between deposition and evaporation, that is, a lurking atmosphere which is neither cold enough to freeze, nor warm enough to send off the su-

perabundant moisture, it may be that this is the time in which the glands of the tender bark of unthinned or improperly thinned larches become affected." Mr. Drummond of Perth, who writes expressly on the canker in the larch, and who contends that the sole cause of it is an excess of cold and moisture in the atmosphere, says, "I do not pretend to account for the physical action of the climate in producing the disease in the plant. Perhaps the injury the foliage sustains may prevent the due perspiration of the plant, and the fluids may be deprived of their proper aerial nourishment necessary for the circulation, or a moist and an excessively cold atmosphere may act upon the open texture of the bark, when the vessels are full of sap, in the same manner as it acts on and destroys certain bulbous roots." "The canker," says Mr. Drummond elsewhere, when stating the grounds of his opinion as to the cause of it, "is invariably to be found in excess in the immediate vicinity of water, marshy ground, on all cold retentive soils, and in situations where hoar-frost prevails. Among trees planted on the sides of mountains, where the soil and adjoining grounds are dry, little or no disease is to be found; but it is quite common on elevated situations if they are exposed to fogs or the vapours arising from damp or marshy ground. I have observed the trees free from disease on a limited extent of marshy ground, and those on the dry ground immediately overhanging it in a diseased state; which would indicate that an excess of moisture at the root is not the cause, but that the exhalations from damp ground have an immediate connexion with it. It has appeared towards the east coast in all its virulence. There is less of it as you proceed to the west; and in Argyshire, where the climate is more temperate (being removed from the influence of the east winds), and where is superabundant atmospheric moisture, the woods are comparatively free from the disease, but which would have been either dead or dying in similar situations in this part of the country. These observations led me to conclude that a moist climate is not alone the cause of the disease, but that it is produced by an excess of cold and moisture in the atmosphere."

Opinions as to fungi being the cause of canker are exceeding various and conflicting. Minute parasitic fungi unquestionably attend most instances of canker, and sometimes exist in such myriads as to impart a peculiar tinge to the whole stem of cankered trees; but very different fungi attack different species of trees, several kinds sometimes attack the same species, and possibly some are either causes or aggravations of canker, while most are merely innocuous effects. The *stromatosphæria multiceps* so commonly and greatly abounds on cankered pear-trees, particularly on the jargonelle, the Windsor, the swan's egg, the summer bergamot, and the autumn bergamot varieties, and seeming to make their young

shoots and even their older branches die away toward the extremity, that it has been regarded by some close observers as the sole cause of their canker; a kind of fungus totally different from this accompanies, and has been thought by some persons to rouse, precisely similar symptoms of canker in apple-trees; and minute fungi of various kinds, particularly of the genera *cladosporium*, *antennaria*, and *helminthosporium*, invariably accompany canker in the larch-trees, and are sometimes so prodigiously abundant as to give the trees the appearance of being coated with soot. But two of the most distinguished fungologists in Britain, after closely examining specimens of cankered larch, expressed a decided opinion that the presence of the fungi was not the cause but a consequence of the disease, and was probably occasioned by the exudation of turpentine; and one of the two—Sir W. J. Hooker—remarked, "Diseased trees exuding moisture, or even in moist seasons, instead of having a clean bark or foliage, are very liable to the attacks of various fungi; but, nevertheless, they do not seem to afford a proper humus to bring them to a state of perfection. I have often observed this to arise again from a bad, and especially cold and wet, state of the soil."

The opinion that canker is occasioned by the weakness of a tree's constitution, by a distemper in all its juices, or by a deficiency in its functional energies, and by a consequent inability to imbibe and elaborate sufficient nourishment for existing organs, and sufficient matter for the formation of new parts,—this opinion makes very ample allowance for the malign influence of bad climate, bad soil, bad cultivation, bad variety of tree, and all sorts of accidents and unfavourable circumstances; and, as maintained by some writers, it even seems to speak of constitutional distemper as a convenient general expression for the operation of all kinds of conceivable causes. G. W. Johnson, Esq., who is a strenuous advocate of this opinion, enumerates and illustrates most of the causes which are usually alleged, and then says, "All these facts unite in assuring us, that the canker arises from the tree's weakness. It matters not whether its energy is broken down by an unnatural rapidity of growth, by a disproportioned excess of branches over the mass of roots, by old age, or by the disorganization of the roots in an ungenial soil; they render the tree incapable of extracting sufficient nourishment from the soil, consequently incapable of developing a sufficient foliage, and therefore unable to digest and elaborate even the scanty sap that is supplied to them."

Both soil and subsoil, in spite of the assertion of a few writers to the contrary, appear to exert a very considerable influence. A wet retentive subsoil does not permit sufficient aeration, cannot perform sufficient digestion, and will not allow a sufficient supply of perfectly fresh elements of healthy sap; and therefore must act

malignly, not alone as a reservoir of cankering vapours, but as an originator of impoverishing and poisonous juices. A deep and very rich soil gives trees a plethoric and dropsical habit, and, in consequence, occasions so powerful a predisposition to canker, that a cure for this disease in an orchard has sometimes been found in the simple process of wheeling away one stratum of the soil, and diluting the remaining stratum. If a subsoil either be ill-drained or consist of ferruginous gravel, or if a soil be clayey and not kept well-drained and porous, all trees which grow upon it, but especially fruit-trees, are exceedingly liable to become cankered. A soil exhausted by long cropping, or charged with the sporidia of accumulated growths of minute epiphytic fungi, is peculiarly unfavourable; and hence an old worn-out orchard, if replanted with fruit-trees, is almost certain to communicate canker to even the most vigorous young plants which can be selected. A cold situation, frequency of raw fogs, and the vernal prevalence of piercing and moist east winds, seem to be the principal cankering elements in climate. Injudicious pruning, bruises, damage to the bark, and all similar accidents, if they do not originate canker, seldom fail to aggravate it. The youngest and most vigorous larch-trees appear to be more subject to canker than the older and less vigorous; yet, with this exception, the oldest trees of any species growing in one group, or in one set of circumstances, whether they be timber-trees or fruit-trees, are more frequently attacked than the younger. Trees of every age are liable to canker; but, as a general rule, all become increasingly liable as they advance in age, and particularly such as have had a vigorous growth in their youth. All grafting varieties of fruit-trees, also, become more and more cankerable as they multiply in reproduction, till they eventually acquire such an accumulation of peccant humour as to be continually diseased, and no longer propagable. The scions of an old variety of fruit-tree merely multiply an aged individual; and though they acquire temporary vigour from the young and stimulating sap of the stocks on which they are grafted, they become, in a few years, as cankerable and decrepid as the parent tree. The golden pippin, the oldest variety of the apple-tree at present cultivated, is more frequently and severely attacked by canker than any other variety. "I do not mean to assert," says Mr. Knight, "that there ever was a time when an apple-tree did not canker on unfavourable soils, or that highly cultivated varieties were not more generally subject to the disease than others, where the soil did not suit them. But I assert, from my own experience and observation within the last twenty years, that this disease becomes progressively more fatal to each variety as the age of that variety, beyond a certain period, increases; that all the varieties of the apple which I have found in the

catalogues of the middle of the seventeenth century, are unproductive of fruit, and in a state of debility and decay."

The sap of a cankered tree acquires an excess of alkaline or saline matter, in consequence apparently of the power of its roots to select suitable food becoming enfeebled. M. Saussure found, in the course of his experiments, that, on account of their losing their sensitiveness and energy necessary for selecting or rejecting, the roots of plants growing in saline solutions absorbed the largest proportions of such salts as were injurious to their health. Thus, when *polygonum persicaria* and *bidens cannabina* were grown in a solution of acetate of lime, sulphate of soda, and chloride of sodium, they wholly rejected the acetate of lime; but when grown in a solution of acetate of lime and sulphate of copper, they abundantly imbibed both of these salts; yet the sulphate of copper was found to be more deleterious to them than any other salt employed in the experiments. The proportions of the salts absorbed in the former of the two solutions were six per cent. of sulphate of soda, and ten of the chloride of sodium; and the proportions in the latter were thirty-four of the sulphate of copper and thirty-one of the acetate of lime. Now roots, though in a less degree, will be debilitated by an ungenial soil as certainly as by a solution of powerfully deleterious salts, and will in consequence absorb soluble alkaline matters in the soil with increasing facility of imbibition and diminishing ability of discrimination; and while the roots will either thus, or by the weakening effects of canker inflicted by other causes, cease to make a healthy performance in taking up liquid nourishment from the soil, the leaves of the debilitated branches will become diminished in at once energy, size, and number, and will fail to effect a sufficient elaboration of the sap for its conversion into healthy cambium. The sap which ought to feed all existing organs and to afford matter for the formation of new ones, is thus at once deficient in quantity, deteriorated in quality, and ill-digested in phylline elaboration; and it therefore corrodes in the vascular system of the tree, and throws out the peculiar crystalline deposits which constitute so singular a symptom of some of the worst kinds of canker.

The prevention and cure of canker are necessarily various, and must, in any one instance, be directed against the special forms which the disease assumes, or the particular cause by which it is excited. If coldness of climate be the only cause which can fairly be assigned for it in any particular orchard, covering with glass is the chief preventive, and this, of course, can be applied to only a few select wall-trees. If fungi can, in any instance, be regarded as a chief exciting cause, a proper remedy might probably be the free use of the knife, and a subsequent copious washing with caustic lime water. If plethoric or dropsi-

cal habit seem to be forming, or have already formed, one of the main roots of the tree may be removed, and an admixture of poor loam, sandy mould, or even of drift sand or any other diluting matter, may be worked into the soil. A cultivator of Devonshire, whose opinions are recorded by Mr. Marshall, believed canker to be caused by excessive fertility in the soil, or a too abundant "dressing" about the roots, and regarded the application of common river sand to the roots as an infallible remedy. If mere weakness of constitution or defect of functional energy appear to be the cause, while no one kind of exciting influence can be detected or inferred, a very efficient remedy, known by experiment to induce a complete cure, is to cut away all the infected parts, and make a judicious pruning among the remaining branches; and even if such exciting circumstances as unfavourable climate, ungenial soil, or previous bad culture can be detected, an excellent effect may be produced by the gradual sawing and cutting away of exuberant or super-numerary shoots and boughs. "If canker in a fruit-tree is a consequence of old age," says Mr. Johnson, "it is probably a premature senility, induced by injudicious management, for very few of our varieties are of an age that insures to them decrepitude. I have never yet known a tree, unless it was in the last stage of decay, that could not be recovered by giving it more air and light, by careful heading in, pruning, improvement of the soil, and cleansing the bark. If the soil, by its ungenial character, induces the disease, the obvious and only remedy is its amelioration; and if the subsoil is the cause of the mischief, the roots must be prevented striking into it. In all cases, it is the best practice to remove the tap-root. Many orchardists pave beneath each tree with tiles and broken bricks. If the trees are planted shallow, as they ought to be, and the surface kept duly fertile, there is not much danger of the roots striking into the worse pasturage of the subsoil." A method of plastering cankered trees with a preparation of cow-dung, lime-rubbish, wood-ashes, and sand, made a vast sensation about half-a-century ago, and was rewarded by a parliamentary grant of money; but it was afterwards shown by Mr. Knight, and is now generally believed, to have been a piece of sheer quackery. Other persons recommend, and many successfully practise, the removal of all decayed or exuviated bark, and the application of various liquid washes, such as a solution of common salt, or a diluted liquid compound of cow-dung, soap-suds, and urine. When any bruise or other injury is inflicted, of a kind likely to induce or develop canker, a piece of living bark from another tree might be exactly fitted into the excision in the same manner as in the operation of budding. The grand preventive of canker in larch is to select, for plantations, such situations and soils as shall not subject the trees to combined coldness and moisture.—*Papers of*

Mr. Jol. son, Mr. Drummond, and Mr. Pearson, in Quarterly Journal of Agriculture.—The Canker Controversy in the Gardener's Gazette.—Keith's Botanical Lexicon.—Marshall's Rural Economy of the West of England.—Loudon's Gardener's Magazine.—Memoirs of the Horticultural Society.

CANKERED GRAIN. Wheat affected with pepperbrand. See the articles PEPPERBRAND and *Æcidium*.

CANNA. A genus of ornamental, evergreen, herbaceous, tropical plants, forming the type of the natural order Cannæ. This order is very nearly allied to that which contains ginger, cardamom, zedoary, turmeric, and other aromatic plants; but though entirely resembling that order, scitamineæ, in appearance and in geographical distribution, it differs in wanting aromatic principle, and in two minute botanical characters of its parts of fructification. The genus *canna* comprises no fewer than nearly forty known species, all of which have been introduced to the gardens of Britain; and it is highly and justly celebrated for the great beauty of its flowers. The Indian species, *Canna Indica*, grows naturally in both the East and the West Indies, and was introduced to Britain in 1570, and, though long very common in greenhouses, continues to possess the fame of one of the most beautiful flowering-plants known to the florist. Its popular name is Indian shot; and this name alludes to the roundness and hardness of its seeds. Its roots are thick, fleshy, tuberous, and divided into many irregular knobs; its stem rises to the height of from two to four feet, and is encompassed by the broad leafy footstalks of the leaves; its leaves are produced in a disorderly manner from the crown of the roots,—they at first are twisted like a horn, but afterwards become expanded, and are nearly a foot in length, and five inches across the middle, gradually diminishing in breadth toward each end, and terminating in a point,—and they have many large transverse veins, running from the midrib to the edges; its flowers are produced in loose spikes at the upper part of the stem, and consist each of one petal, cut nearly to the bottom into six slender segments, the upper three of which are the broadest and of a bright scarlet colour, while the other three are narrower and have a mixture of a paler colour; and its fruit is a capsule which opens lengthways into three cells, filled with round, hard, black, shining seeds. This plant properly flowers in June and July; but, when properly managed, it always flowers again in winter and spring; and it can easily be so treated as to flower during the greater part of the year. It needs during winter the heat either of a hot-house or of the warmest nook and degree of the greenhouse; yet, in summer, can be placed with tender exotics, in a sheltered situation in the open air, and has even been successfully treated as if it were half-hardy. The Hindoos make necklaces and other ornaments of its seeds. A

variety of it called the spotted, *C. I. maculata*, carries reddish-yellow flowers.—The lofty and the broad-leaved species, *C. exotica* and *C. latifolia*, the former carrying scarlet flowers, and the latter pink-coloured flowers, were introduced from Brazil in 1820, and usually grow to the height of respectively sixteen and ten feet. The other species grow to heights varying from two to six feet; most carry scarlet or crimson-coloured flowers, and some carry flowers of yellow, carmine, brown, orange, and reddish-yellow colour; and, with scarcely an exception, they are very decidedly handsome. The eatable species, *C. edulis*, is cultivated in Peru as an esculent, and may possibly be capable of cultivation in the open ground, in the extreme south of England. This species was introduced from Peru in 1820; and another esculent species, *C. esculenta*, was introduced from South America in 1822. These two species, and indeed the whole genus, possess a very close relationship to the arrow-root plants.

CANNABIS. See HEMP.

CANTER. See AMBLE.

CANTERBURY BELLS. See BELLFLOWER.

CANTHARIDES. The name of a kind of fly, —the *Cantharis vesicatoria* of Geoffroy,—*Meloe vesicatoria* of Linnaeus,—*Lytta vesicatoria* of Fabricius; belonging to the family of the *Trachelides*. They are very common in Spain, Italy, and France, where they are found in large families on the ash, lilac, viburnum, &c. Their body is from 6 to 10 lines long; the feelers are black, setaceous, composed of 12 articulations; the elytra long, flexible, of a shining, golden green, and the tarsæ of a deep brown. Their odour is strong, penetrating, peculiar, and unpleasant; their taste extremely acrid; their powder is of a brownish-grey, intermixed with shining particles of a metallic green colour. According to Robiquet, they contain, with several other ingredients, a peculiar substance, called *cantharidin*. These insects are, of all the vesicating substances, those which are most commonly used. Their action is principally confined to the skin; however, their active principles may be absorbed, and cause serious accidents. The application of a blister is often followed by strangury, hæmaturia, priapism, &c. Taken internally, they act as the most energetic acrid poison; they produce irritation on the intestines, and especially affect the genito-urinary organs, which they stimulate violently. In certain disorders, they are administered in small doses, as powerful stimulants. The medicine is of a very dangerous character, and its use requires the greatest caution on the part of the physician. Several species of blistering fly are found in the United States, some of which are more powerful than the Spanish fly. In veterinary practice, cantharides form the chiefly active ingredient of all the best blisters, whether unguent or liquid; and they are also administered internally, in very small doses, as a remedy

for glanders and for extreme debility. See the articles **BLISTER** and **GLANDERS**.

CANTHARIDIN. The vesicating principle of the cantharides, or Spanish fly; it is white, in small crystalline scales, insoluble in water and cold alcohol, soluble in ether, boiling oils and alcohol, from which it precipitates by cooling. The vesicating properties could be extracted from cantharides by oil of turpentine, and probably a satisfactory ointment be prepared by merely evaporating the oil of turpentine at a moderate temperature.

CANVAS SHEDS. Tarpaulin sheds for affording shelter to sheep. They are particularly valuable in bleak highland districts where timber is scarce and high-priced; and can be maintained in even woodland districts, at a less cost than timber sheds. Each may be formed of light and closely-woven tarred canvas; it may be made about two yards wide, and about forty yards long, or of any length to correspond with the principal folds; it may be erected along a stone-wall of about 5½ feet high, so as to have the wall for its back, and may easily be made water-tight along its line of junction with the edge or summit of the wall; it may be erected and made firm with common posts and head-rails, one range of posts being placed along the back, another range placed along the front, and the latter only three feet high, and multitudinously connected with the former by transverse head-rails or very slender rafters; it may be tied at so very many points to both the longitudinal and the transverse head-rails as to offer perfect resistance to any force of wind which might otherwise raise or disturb it; and it may be provided along the back with simple racks, for holding the sheep's food. A simple contrivance like this will keep sheep exceedingly snug amid the storms of winter; it would be of great value during the sheep-shearing season, in a rainy district; and something similar to it might be eminently serviceable for sheltering cattle on the grass-farms of Skye, and of similar bleak feeding districts of the Hebrides or the Scottish Highlands.

CAOUTCHOUC. A vegetable principle existing in the milky juices of many genera and species of plants; and hence there may be several varieties of it. It is obtained from the *Siphonia elastica*, *S. Cahuchu* of S. America; *Artocarpus incisa*, *integrifolia* of the West Indies; *Urceola elastica* of Sumatra and Java; *Ficus elastica*, *religiosa*, *indica*, &c., of the East Indies; farther from the *Castilleja elastica*, *Cecropia peltata*, *Hippomene biglandulosa*. It exists in the milk of many Euphorbiaceæ, Papaveraceæ, in *Lactuca*, *Asclepias*, *Leontodon*, &c., &c. When any of these plants is incised, there exudes a milky juice, which, by exposure to the air, gradually lets fall concrete caoutchouc. The juice is pale yellow, thick, and similar to cream; its odour is sourish and putrid; specific gravity = 1.01174; when spread in thin layers on a solid body it

soon becomes solid caoutchouc, amounting to 45 per cent. of the weight of the juice. Faraday's analysis of the juice gave, caoutchouc 31.7; albumen 1.9; a bitter nitrogenous matter, soluble in water and alcohol, and precipitable by nitrate of lead, 7.13; a substance insoluble in water and alcohol 2.9; water with a little free acid 56.37. The caoutchouc floats in it in globules, and it is immediately congealed by heat or alcohol; the particles deposit by standing; it is miscible in all proportions with water.

Caoutchouc has a pale yellow colour, and is destitute both of taste and smell. The black colour of caoutchouc is owing to the method of drying it after it has been spread upon moulds; by exposing it to smoke, after each successive coat. At 32° it is hard, and has little elasticity, but when heated to 60° or 70°, becomes soft and pliable like leather, is exceeding elastic and adhesive; and cannot be broken without considerable force.

Caoutchouc is insoluble in water, alcohol, acids, or alkalis; by long boiling in water it softens and swells up, and is then acted on with greater facility by different menstrua, but when exposed to the air, it resumes its former state. Caoutchouc is slightly soluble in ether. Dilute acids do not act upon it. Sulphuric acid dissolves it after long digestion without forming tannin; when heat is applied, it is converted into a terebinthic mass. It is rapidly acted on by fuming nitric acid, nitric oxide being evolved. Muriatic acid does not affect it. It is not attacked by gases, such as chlorine, sulphurous, fluosilicic, but easily by nitrous vapours. When heated to a temperature of about 248°, it melts, and on cooling, remains in a semifluid adhesive state, but when exposed to the air in thin layers, it gradually acquires hardness. When heated sufficiently in the air, it smokes, giving out an odour which is not disagreeable, then takes fire, burning with a strong yellow flame and much smoke. When pure caoutchouc is distilled, there passes off a large quantity of combustible gas, but neither carbonic acid nor ammonia; if impure it evolves all these. The chief product is caoutchucin or caoutchouc oil.

Caoutchouc manufacture.—This department of industry, which had its birth but a few years since, has grown so rapidly and exhibited such a variety of novel, ingenious, and useful applications, within a short period of time, that it may already take high stand among the ancient mechanical arts, since in a vast number of instances it supersedes the use of woven textures, leather, &c. Its elasticity, resistance to wear and tear of surface, to chemical reagents, its closeness of texture, &c., are qualities which will insure its eminence, as soon as improved mechanism shall enable the manufacturer to throw it into any required form. We can now observe it replacing woven goods to a limited extent; we find it now made into almost every possible variety of leather

though far surpassing the latter in most of its qualities; it can be made into a paper; it can be made of any required thickness or thinness; it will receive white and coloured grounds, on which more delicate lines of engraving are impressed than on any kind of paper; articles are made up from these materials with great ease and rapidity by simply cutting out and cementing pieces together more firmly than can be effected by the needle. We distinguish two kinds of caoutchouc,—the common material, and that composed according to Goodyear's process.

The crude material, as imported in skinny shreds, fibrous balls, twisted concretions, cheese-like cakes, and irregular masses, is more or less impure, and sometimes fraudulently interstratified with earthy matter. It is cleansed by being cut into small pieces, and washed in warm water. It is now dried on iron trays, heated with steam, while being carefully stirred about to separate any remaining dirt, and is then passed through, between a pair of iron rollers, under a stream of water, whereby it gets a second washing, and becomes at the same time equalized by the separate pieces being blended together. The shreds and cuttings thus laminated, if still foul or heterogeneous, are thrown back into a kind of hopper over the rollers, set one-sixteenth of an inch apart, and passed several times through between them. The large and thick tables of the gum are sliced into cakes for the stationer, and into sheets for making tapes and threads of caoutchouc. The thin slices constitute what is called sheet-caoutchouc, and they serve tolerably for making tubes for pneumatic apparatus, and sheaths of every kind; since, if their two edges be cut obliquely with clean scissors, they may be made to coalesce, by gentle pressure, so intimately, that the line of junction cannot be discovered either by the eye or by inflation of a bag or tube thus formed. Sheets of caoutchouc are cut into continuous threads by highly ingenious machines. The threads of caoutchouc are readily pieced by paring the broken ends obliquely with scissors, and then pressing them together with clean fingers, taking care to admit no grease or moisture within the junction line. These threads must be deprived of their elasticity before they can be made subservient to any torsile or textile manufacture. Each thread is *inelasticated* individually in the act of reeling by the tenter boy or girl pressing it between his moist thumb and finger, so as to stretch it to at least eight times its natural length, while it is drawn rapidly through between them by the rotation of a power-driven reel. This extension is accompanied with condensation of the caoutchouc, and with very considerable disengagement of heat. The reels, after being completely filled with the thread, are laid aside for some days, more or fewer, according to the quality of the caoutchouc,—the recomposed requiring a longer period than the bottle-material. When thus rendered inelastic, it is wound

off upon bobbins of various sizes, adapted to various sizes of braiding, or other machines, where it is to be clothed with cotton or other yarn.

For waterproof fabrics, the parings, the waste of the kneading operations above described, and the coarsest qualities of imported caoutchouc, such as the inelastic lumps from Para, are worked up into varnish, wherewith two surfaces of cloth are cemented, so as to form a compound fabric, impervious to air and water. The caoutchouc is dissolved either in petroleum (coal-tar), naphtha, or oil of turpentine, by being triturated with either of the solvents in a close cast-iron vessel, with a stirring apparatus, moved by mechanical power. The heat generated during the attrition of the caoutchouc is sufficient to favour the solution, without the application of fuel in any way. Three days are required to complete the solution of one charge of the varnish materials. The proportion of the solvent oils varies with the object in view, being always much less in weight than the caoutchouc.

Metallic Gum Elastic Composition.—The following specification and claim of Goodyear's Patent is from the Journal of the Franklin Institute. "My principal improvement consists in the combining of sulphur and white lead with India rubber, and in the submitting of the compound, thus formed, to the action of heat, at a regulated temperature; by which combination and exposure to heat it will be so far altered in its qualities as not to become softened by exposure to the solar rays, or of artificial heat, at a temperature below that to which it was submitted in its preparation, say to a heat of 270° of Fahrenheit's scale; nor will it be injuriously affected by exposure to cold; it will also resist the action of the expressed oils, and that, likewise, of spirits of turpentine, and of the other essential oils, at common temperatures, which oils are its usual solvents." The compound may be formed of various proportions of the ingredients, but that which is deemed best consists of twenty-five parts of India rubber, five of sulphur, and seven of white lead—the India rubber having been previously dissolved in some of the essential oils, and the sulphur and white lead ground in the manner of preparing paint.

"I have repeatedly experimented on this composition," says Mr. Booth, "which is a singular compound of sulphuret of lead with caoutchouc, and found it materially altered in some of its properties. It is more perfectly elastic than common caoutchouc, for after a long continued compression or extension, it returns precisely to its former dimensions; it seems to possess greater tenacity, requiring a considerable force to produce rupture; it is equally flexible, or nearly so, in summer and winter temperatures, differing in this respect remarkably from common caoutchouc; it resists the action of the usual solvents of caoutchouc in an extraordinary degree, being insoluble in ether and the essential oils, and

scarcely affected by acids, excepting by oil of vitriol. The long-continued action of the essential oils renders it softer and brittle; but its original qualities may be more or less restored. It resists wear and tear of surface still more powerfully than common caoutchouc, for after a mail-bag composed of it had been dragged over many miles of a macadamized road, the iron staples and nails were worn nearly through, while the elastic material was scarcely abraded. The ease and rapidity with which various articles, such as harness, shoes, &c., &c., can be joined together by the simple use of a cement and subsequently rendered firm by the heating process, prove conclusively, when joined to the qualities above enumerated, that fibrous textures of cotton, &c., covered with this composition, will be substituted for the various kinds of leather, in many branches of the latter manufacture. Having employed various articles in ordinary dress and in chemical operations made of the composition, or of cloth covered with it, and having seen nearly all the applications enumerated below, I can subscribe to the following enumeration of qualities and applications by the patentee:

“No degree of heat, without blaze, can melt it; it remains unaltered in the torrid zone; heat, without blaze, more intense than 280° F., chars it like wood; it continues flexible in great degrees of cold, and even by the contact of ice is not stiffened; in durability it surpasses any other material applicable to similar uses; its elastic power is superior to that of common India rubber, and is retained unaffected by heat, cold, or continued stretching; of itself, or in combination with fabrics of cotton, or other material, it can be made of any desirable strength, with or without elasticity; it resists powerful chemical reagents; aqua fortis, sulphuric acid, essential and common oils, turpentine, and other solvents, which destroy the native gum, wood, leather, and metals, produce no effect upon this composition, except that long continued immersion in strong aqua fortis, or sulphuric acid, chars it; it possesses valuable medical qualities, being a substitute for oiled silk, furnishing hydrostatic beds, and a great variety of articles used in surgery; it, as well as the fabrics with which it is used in combination, can be washed in boiling water, with lime or lye, without injury; like other gum-elastic compositions, it is water-and-air-proof; it is not liable to be injured by rats, moths, or other vermin; it can be moulded or embossed like wax, and can be prepared in sheets of any thickness or thinness; it will take any colour; it will take japan varnish, and equals in beauty patent leather, as it surpasses it in many other qualities; it takes impressions more delicately than the finest paper; it can be woven or braided; it can be napped, like broadcloth or plush; it can be rendered perfectly tasteless, and inoffensive in point of odour; its contraction, after having been stretched in threads between two adhering thicknesses of

cotton, silk, or other flexible material, shirs or corrugates the fabric in a new and beautiful manner, and renders it applicable to a variety of uses. It is for many purposes a cheaper and better substitute for leather, cloth, and hair-cloth, oiled cloth, oiled silk, paper, and parchment, while the shirred or corrugated goods are peculiar, and for many purposes unrivalled. It can be economically and usefully employed in almost every article of external clothing, particularly where protection from cold and rain, or durability, is desired; in trimming carriages; for harness of all kinds; in building, particularly for roofs and cisterns; in furniture (land and sea), particularly for carpets, printed floor-cloths, &c.; for firemen's dresses; for water hose; for the binding of books; as a substitute for paper and parchment, and for maps and charts; for the canvas and rigging of ships, supplying them also with compact boats, life preservers, rope and tarpaulins, and perhaps with sheathing and caulking materials; for belts and banding of machinery, and for smiths' bellows; for bags, bagging, compact casks, used in securing and transporting merchandise, dry or liquid; in many branches of the arts, as tubes for conveying various liquids, as vessels for containing them for evaporation and for crystallization.”

CAPER,—botanically *Capparis*. A large genus of ornamental plants, forming the type of the natural order Capparidæ. This order is closely allied to the cruciferae, and possesses identical or very similar properties. Most of its species abound chiefly within the tropics; but some are diffused throughout the temperate zones. The number of genera is eleven; and the number of species in the gardens of Britain is nearly eighty. The genus *capparis* alone comprises about thirty species in Britain, and a total of about one hundred and twenty species. Most of these species have the reputation of being stimulating, aperient, and antiscorbutic; and the greater number of those in British gardens are handsome, evergreen, hothouse shrubs, carrying white flowers and attaining a height of from three to eight feet,—and three of them from ten to eighteen feet; but the species of prime interest, throwing all the others completely into the shade, is the common spiny species, *Capparis spinosa*, which produces the well-known capers of commerce.

The common spiny caper grows naturally in Italy, in the south of France, and in other parts of the sea-board of the Mediterranean; and was introduced thence to Britain toward the close of the 16th century. It has a similar habit to the common bramble, and grows among rubbish, in the fissures of rocks, in the joints of old walls, and in other similar situations. Its stem is covered with a white bark, has usually a height of about a yard, and sends out many slender, lateral branches; the leaves are produced on foot-stalks from between two short crooked spines

and the branches, and are smooth, round, and entire; and the flowers are produced on long footstalks at the intermediate joints between the branches, and have five large, white, rounded, concave, expanded petals, a great number of long stamina, and a style rising from among the stamina, and above them, and crowned with an oval germen, which becomes a capsule, filled with kidney-shaped seeds. The bark of the root is sometimes employed in medicine; it is supposed to possess discussive and splenic properties, and to be useful in gout; and it has an exceedingly disagreeable sharp taste, and an equally disagreeable mode of action. But its flower-buds, gathered while undeveloped or rotund like seeds, and immediately thrown into vinegar for preservation, form the grand feature of value, and have, since at least the times of the ancient Greeks, been regarded by almost all gourmands as an exceedingly delicate and quite inimitable pickle.

This species is cultivated in Spain, Italy, Sicily, and the south and centre of France, for supplying the market with capers; and it requires little care, and is of very easy management. In autumn, the stems of the plants are cut down to within six inches of the ground, and are covered all over with soil from the intermediate spaces; and, in spring, they are uncovered and trimmed, and are dressed or earthed up with soil to the points at which the new shoots are likely to be produced. In the latter part of spring, they begin to bear flower buds; and during the whole season till the restraining of the flow of sap, or throughout a period of about six months, they continue to yield an unintermitted series of buds. A gathering of buds is made every morning, and immediately thrown into a tub of vinegar; gathering after gathering, throughout the season, is thrown into the same tub; and a little common salt is dissolved in the vinegar in order to prevent bad effects from a diluting of it with the watery portion of the buds. At the end of the season, caper merchants, who travel through the country for the purpose, purchase the accumulations of gatherings in the tubs, and, partly by sifting them through sieves, partly by testing the quality of the vinegar, divide them into sorts. The smallest are the most highly esteemed; the next in size are next in esteem; three other sizes are of gradually decreasing value; and all the five sizes are completely separated from one another, disposed for sale in five distinct sets of bottles, jars, and barrels, and named respectively the nonpareille, the capucine, the capote, the secondes and the tierces.

When a weak or inferior vinegar is used in the pickling of the capers, the contents of a bottle of them, on being exposed to an influx of fresh air, are speedily decomposed, and pass into a gelatinous substance, containing a large proportion of the peculiar proximate element, which often abounds in breweries, and which has received the name of nanceic acid.—The sieves of the

caper merchants in the south of Europe are made wholly of copper and copper-wire; they deliver up a proportion of their substance into combination with vinegar to form acetate of copper; and this poisonous salt, whenever in any considerable quantity, tinges the capers with a green colour, and causes the violent pains in the stomach and bowels with which caper-eaters are often afflicted. The absurd preference which connoisseurs give to green capers, is based on profound ignorance of this fact, and occasions the noxious kinds of capers to be selected, and the innocuous kinds to be depreciated or rejected. As sugar so far decomposes salts of copper as to destroy their poisonous qualities, a proportion of it ought to be added to the sauce of all capers which have any tinge of greenish colour.

The common caper-bush, though usually treated as a hothouse plant in Great Britain, is believed to be capable of cultivation in the open ground in the south of England. Some seeds experimentally sown at Camden House succeeded better in the open rubbish of a wall than in a hotbed, and even stood uninjuredly over the winter without shelter. "The second year," says the experimenter, "those plants in the walls made shoots of a foot in length; while those in the pots hardly added two inches to their height. The third year, in April, I cut the shoots of the foregoing summer from the plants that were abroad, leaving only a bud or two of each near the original stem, which the same summer made shoots nearly three feet long, to the number of about forty upon each plant, and put out buds for blossoms; but the plants in the pots did not advance above two inches. In short, the last year, one single plant in the wall had not less than a quart of blossom buds upon it fit to pickle, and the plant perfected some of its fruit. Thus, if the plant be headed down in the spring like a willow, it will every summer make a beautiful bush, and afford as good capers as grow in Italy."—The ovate species, *C. ovata* or *Fontanesii*, is very similar, in height, habit, and native country, to the common species, and is almost quite hardy in England. Several species formerly included in the genus *Capparis*, are now assigned to the genera *niebuhria*, *crataeva*, *morrisonia*, and *stephania*.—*Bradley's Works of Nature*.—*The Gardener's Gazette*.—*The Magazine of Domestic Economy*.—*Miller's Gardener's Dictionary*.—*Loudon's Encyclopædia of Plants*.—*Loudon's Hortus Britannicus*.

CAPERCAILZIE, — scientifically *Tetrao Urogallus*. The largest species of the grouse tribe of birds. It is also called capercaillie, capercale, capecali, cock of the woods, and cock of the mountain. It abounds in Sweden, Norway, northern Asia, and some parts of Russia, Germany, and Hungary; and is somewhat abundantly supplied from the sea-board of the Baltic to the market of London. It formerly abounded in the Highlands of Scotland, and in some parts of Ireland, but was exterminated, partly from rapacious pursuit

of it by sportsmen, partly by the increase of human population, partly by the cutting down of ancient forests, and partly by the reclamation and improvement of mountain wastes; but it has, of late years, been reintroduced to several upland estates from the continent of Europe, and it may possibly become once more a somewhat familiar traverser of our highland wildernesses. The male is about as large as a turkey, or about 2½ feet in length, and weighs from twelve to fifteen pounds; and his windpipe makes a loose fold of two curves before entering the chest, so as considerably to increase his apparent length. His bill is convex, very strong, and of the colour of horn; his eyes have a hazel colour; the skin above the eyes is naked, and of a bright red colour; his legs are very strong, and covered with brown feathers; and his plumage is, on the upper part, chestnut brown, irregularly marked with blackish lines,—on the breast, glossy greenish black, passing on the under surface into black,—and in the tail, and the elongated feathers of the throat, black. The crow of the male is of a peculiar kind, and uttered chiefly in the morning, and is so loud as to be heard at the distance of several miles. The female is considerably smaller than the male, and differs widely from him in colour: her head, her neck, and her back are marked with transverse bars of red and black; and her under surface is of a pale orange-yellow colour, barred with black. The number of eggs which she lays is from eight to sixteen. The capercailzie is exceedingly shy, and avoids the vicinity of human abodes: yet it is frequently reared as a domestic fowl in Sweden; and it is then bold and pugnacious like the turkey-cock.

CAPIAS. In the law of England, a writ or process, of which there are several kinds.

Capias ad respondendum, is a writ sued out before judgment, where an *original* is taken out, &c., to take the defendant, who had neglected to appear in the previous process, and make him answer the plaintiff. If, therefore, the defendant, being summoned, makes default, or if the sheriff returns a *nihil*, or that the defendant hath nothing whereby he may be summoned, attached, or distrained, the *capias* usually issues, commanding the sheriff to take the body of the defendant, and keep him, so as he may present him in court on the day of the return. This writ, and all others subsequent to the original,—not issuing out of chancery, but from the court into which the original was returnable, grounded on what has passed in that court, in consequence of the sheriff's return, issuing under the private seal of that court, and not under the great seal of England; and *teste'd.*—not in the king's name, but in that of the chief justice only, are called *judicial*, not *original* writs. And these several writs must respectively bear date, the same day on which the writ immediately preceding was returnable. But it is now the usual practice to sue out the *capias*, in the first instance, upon a supposed re-

turn of the sheriff; and, afterwards, a fictitious original is drawn up, and a proper return thereupon, in order to give the proceedings a colour of regularity. If the sheriff of the county, in which the injury is supposed to be committed, and the action is laid, cannot find the defendant in his jurisdiction, he returns *non est inventus*; upon which another writ issues, called a *testatum capias*, directed to the sheriff of the county where the defendant is supposed to reside. But in this case, also, it is usual to make out a *testatum capias* at the first, on the supposition that not only an *original*, but a previous *capias* had been granted, although in reality they never were. When a defendant absconds, however, and the plaintiff would proceed to an outlawry against him, an original writ must be sued out regularly, and after that a *capias*. And if the sheriff returns a *non est inventus* upon the first *capias*, then there issues an *alias*, and after that a *pluries* writ; and if a *non est inventus* be returned upon all of these, then a writ of *exigent* may be sued out in order to outlawry. By the act, such was the first process in the Court of Common Pleas. In the King's Bench, also, they frequently proceeded by *original* writ, with *attachment* and *capias*, particularly in actions of ejectment and trespass: the writ, however, was returnable, not at Westminster, where the Common Pleas are fixed by Magna Charta, but *ubicunque fuerimus in Anglia*; the King's Bench being removable into any part of England, at the pleasure of the Crown. By the recent act 2 Will. IV., c. 39, the force of writ of *capias ad respondendum* is the same in all courts.

Capias ad satisfaciendum, is a writ of execution, after judgment, the intent of which is to imprison the body of the defendant, until he makes satisfaction to the plaintiff for the debt, costs, and damages, in a process. This writ, therefore, does not lie against privileged persons, peers, members of parliament, executors or administrators, nor against such other persons as could not be originally held to bail.

Capias utlagatum, is a writ which lies to arrest a person who appears publicly after outlawry, who may be committed until the outlawry be reversed.

Capias pro fine, is a writ which issues for taking the body of one who is fined to the king for some offence, and does not discharge the fine according to the judgment. By the statute 5 and 6 W. & M. c. 12, *capiatur fines* are taken away in several cases.

Capias in withernam, is a writ which lies for recovering goods or cattle taken in distress, when the sheriff's inquest determines against the distreiner. If the distress be taken out of the county, or concealed, so that the sheriff cannot make deliverance in *replevin*, then there issues to him a *capias in withernam*, or in *vetito namio*, a term which signifies a reciprocal distress, to take as many goods or cattle of the distreiner, by way of reprisals.

Capias ad audiendum judicium, is a writ which issues against one who has been found guilty of a misdemeanor, to bring him in to receive his judgment; and if he absconds, he may be prosecuted, even to outlawry.

CAPILLARIES. The innumerable, minute, and terminational ramifications of the arteries, in the circulating system of red-blooded animals. They derive their name from the circumstance of their being so slender and fine as to resemble hairs; but they actually become so minute as to be invisible, and are so multitudinously ramified that some one or more of them are wounded by the slightest puncture. These countless and wonderfully minute vessels make all the depositions of nourishment and secretion which the arterial blood conveys to the several parts of all the members of the body; and hence, when they begin to unite, to enlarge, and to connect themselves with the veins, they deliver black or venous blood, instead of the red or arterial blood which they had received. The capillaries are thus the seat of secretion and the link between the arteries and the veins; but the points at which they lose their arterial character, and assume their venous one, are too recondite and microscopic to be capable of observation.

CAPILLARY ATTRACTION. A term of frequent occurrence in physics, signifying properly that force by which water, mercury, or any other fluid, is raised above its level in tubes whose diameter does not exceed that of a hair, hence called *capillary tubes*. It is now employed, in a more general sense, to denote that force with which solids act upon fluids, either in raising them above, or depressing them below, their natural level, when the solid is simply immersed in the fluid, or when the fluid is included in a tube, or between two plates formed from the solid. In attempting to give as complete a view of this interesting portion of physics as the limits of our work will permit, we shall direct our readers' attention to the different phenomena of capillary attraction, as they have been ascertained by direct experiment, and to the different theories by which these phenomena have been explained.

Exp. 1. If water, or any other fluid, excepting mercury and the metals in a fluid state, be poured into a clean vessel, the fluid in contact with the sides of the vessel will be raised above the level of the fluid in the middle of the vessel, and the fluid surface will be terminated by an elevated ring of fluid. See *Plate XV., Fig. 1*, where A, B are the sides of the vessel, and c, d, the elevated fluid.

Exp. 2. If a solid body is immersed in a fluid, the fluid will be raised round the sides of the solid, as in *Fig. 2*, where S is the solid, and c d the elevated fluid.

Exp. 3. If the fluid, used in experiments 1 and 2, is mercury, or any metal in a state of fusion, the fluid in contact with the sides of the vessel in *Exp. 1*, or with the sides of the solid body in *Exp. 2*, will be depressed below the general level, as is exhibited in *Figs. 3d and 4th*.

Exp. 4. If a glass tube A, *Fig. 5*, whose internal diameter or bore is less than the 10th of an inch, be

immersed at one end into a fluid in the vessel MN, the fluid will rise to A to a considerable height above the fluid surface. If another capillary tube B of a greater bore is immersed in the same fluid, the fluid will also rise in the tube above its level, but not to such a height as in the tube A. By comparing the heights of the fluid in the two tubes, with the diameters of their bores, it is found that the heights are inversely as the diameters.

Exp. 5. If the preceding experiment is tried with fluids of different kinds, it will be found that they rise to different altitudes.

Exp. 6. If tubes of different lengths are employed, the fluid will never ascend to the top of the tube, however short. Thus in *Fig. 5*, if the tube AC is broken off at P, the fluid will stand at p below the top P, though it formerly rose as high as A.

Exp. 7. If a capillary tube, composed of two cylinders of different bores, be immersed in a fluid first with the widest part downwards, as at E, *Fig. 5*, and afterwards with the narrowest part downwards, as at F, *Fig. 5*, the fluid will ascend in both cases to the same height.

Exp. 8. When the widest part of the tube is not capillary, but is of such a magnitude that the fluid will not rise spontaneously to the smaller part, let the wider part be filled by suction, and the fluid will stand at the same height in the smaller part of the tube, as it would have done had the whole tube been of the same bore with the capillary part.

Exp. 9. If the tube, when filled by suction, as in the preceding experiment, be placed in the receiver of an air-pump, and the air exhausted, the fluid in the wider part of the tube will not remain suspended in the tube as formerly, but will fall down into the vessel.

Exp. 10. If one tube is placed within another so that their axes coincide, the water will rise in the space between the tubes only to half the height that it would have done in a single tube, in which the diameter of the bore is equal to the interval between the two tubes.

Exp. 11. When the internal diameter of several capillary tubes are equal, the fluid will rise to the same height whether the tubes are thin or thick.

Exp. 12. Having plunged a capillary tube into water, let the lower extremity of it be closed with the finger, and when the tube is taken out of the water, let its external surface be gently wiped. Upon withdrawing the finger, the water is seen to subside in the tube and form a drop at its lower base; but the height of the column is always greater than the elevation of the water in the tube, in the common experiment of plunging it in water. It has also been observed, that the increase in the elevation of the water is more considerable, the smaller the diameter of the drop beneath.

Exp. 13. If a drop of water is introduced into a conical capillary tube, open at both ends, and held in a horizontal position, it will move towards the vertex of the cone.

Exp. 14. When water is forced through a capillary tube, of such a bore that it is discharged only in successive drops, it will flow in a constant and accelerated stream when the tube is electrified, and the acceleration will be inversely proportional to the diameter of the bore.

Exp. 15. A capillary syphon which discharges cold water only by drops, will discharge water of a higher temperature in a continued stream.

Exp. 16. Let a capillary tube be held in a position inclined to the horizon, and let a drop of liquid be let fall upon its surface, then bringing the tube into a vertical position at the instant when the drop has arrived at the inferior orifice, the fluid will run through the orifice, and rise in the interior of the tube.

Exp. 17. If the preceding experiments with capillary tubes, excepting *Exp. 9*, be made in the exhausted receiver of an air-pump, the fluids will rise to the same height as in the open air.

Exp. 18. If the bore of a capillary tube be lined with a very thin coating of grease, or any unctuous substance, the water will not ascend in the tube.

Exp. 19. By observing carefully the upper surface of the column of fluid, elevated in capillary tubes, it will be found to be concave upwards. *M. Haüy* found, that in capillary tubes of glass, of very small diameters, the concave surfaces of water and of oils differ very little from the form of a hemisphere.

Exp. 20. If the capillary tube is taken out of the fluid in which it is immersed, and inclined to the horizon so that the included fluid may obey the action of gravity, the concavity will appear at both ends of the column, and suffers no variation either in its shape or size, whether the tube be held in a vertical, a horizontal, or an oblique direction.

Exp. 21. When the column of water is thus made to move along the tube, it seems to suffer a resistance as it approaches to either end, and it does not completely reach the extremity of the tube till the tube is almost inverted.

Exp. 22. When a capillary tube is immersed in mercury, or in any metal in a state of fusion, the fluid, instead of rising, is depressed in the tube below the general level. See *Fig. 4*.

Exp. 23. If a drop of mercury be introduced into a conical capillary tube, held in a horizontal position, the mercury will move towards the wide end.

Exp. 24. By observing the surface of a column of mercury depressed in a capillary tube, or enclosed in a barometer tube, it will be found to be convex upwards. *Mr. Haüy* has endeavoured to show, that this convexity differs very little from the form of a hemisphere. *Dr. T. Young* maintains that this result is inaccurate, and that the angle formed by the surface of the mercury with the side of the tube is 140° .

Exp. 25. When the mercury and the capillary tube are perfectly dry, the fluid will rise above the general level, like all other liquids. By drying the mercury and the tube to a very great degree, *Messrs. La Place and Lavoisier* constructed barometers, in which the mercurial column was terminated above by a plane surface, and they even succeeded in rendering the upper surface of the mercury concave. The observations given under *Exp. 24* are referable to barometers constructed in the usual way.

Exp. 26. If two plates of glass be placed parallel to each other, at the distance of about $\frac{1}{100}$ of an inch, the water in which they are immersed will rise one inch above its level in the vessel; and when the plates are placed at different distances, the heights to which the water will rise, will be reciprocally proportional to the distances of the plates.

Exp. 27. If a capillary tube be taken of such a magnitude that the diameter of its bore is equal to the distance between the plates in the preceding experiment, the water will rise in it to the same height as between the plates.

Exp. 28. If a fluid is either elevated or depressed between two vertical and parallel planes, the planes will tend to approach each other.

Exp. 29. "If two plane polished plates of glass, three or four inches broad, and twenty or twenty-five long, be laid one of them parallel to the horizon, the other upon the first, so as at one of their ends to touch one another, and contain an angle of about 10 or 15 minutes, and the same be first moistened on their inward sides with a clean cloth dipped into oil of oranges, or spirit of turpentine, and a drop or two of the oil or spirit be let fall upon the lower glass at the other end; so soon as the upper glass is laid down

upon the lower, so as to touch it at one end as above, and to touch the drop at the other end, making with the lower glass an angle of about 10 or 15 minutes; the drop will begin to move towards the concurrence of the glasses, and will continue to move with an accelerated motion till it arrives at that concurrence of the glasses. For the two glasses attract the drop, and make it run that way towards which the attractions incline. And if when the drop is in motion, you lift up that end of the glasses where they meet, and towards which the drop moves, the drop will ascend between the glasses, and therefore is attracted. And as you lift up the glasses more and more, the drop will ascend slower and slower, and at length rest, being then carried downwards by its weight as much as upwards by the attraction. And by this means you may know the force by which the drop is attracted at all distances from the concurrence of the glasses. Now, by some experiments of this kind, it has been found that the attraction is almost reciprocally in a duplicate proportion of the distance of the middle of the drop from the concurrence of the glasses, viz., reciprocally in a simple proportion, by reason of the spreading of the drop, and its touching each glass in a larger surface; and again reciprocally in a simple proportion, by reason of the attraction growing stronger within the same quantity of attracting surface. The attraction therefore within the same quantity of attracting surface is reciprocally as the distance between the glasses. And, therefore, where the distance is exceeding small, the attraction must be exceeding great." *Newton's Optics*, p. 367.

Exp. 30. If the plates in *Exp. 26* are inclined to each other at a small angle, and are immersed in water with the line of their intersection vertical, the water will ascend between them, and will form a beautiful curve. This experiment is represented in *Fig. 6*.

Dr. Hooke, who was one of the earliest writers on capillary attraction, ascribed the ascent of fluids, in capillary tubes, to the unequal pressure of the atmosphere, arising from a diminution of the pressure of the air in consequence of its friction in the tube. This opinion was maintained till the experiment was tried in the receiver of an air-pump, and when the fluid was found to rise as high in vacuo as in the open air, a new cause was sought for the phenomenon. *Sir Isaac Newton* and *Mr. Hauksbee* were of opinion, that the attraction of the tube was insensible at sensible distances. *Dr. Jurin* ascribed the suspension of the fluid to the attraction of the ring of glass to which the upper surface of the water is contiguous, and adheres. *Dr. Hamilton* and *Dr. Matthew Young* maintained, that the fluid was elevated by the lower ring of glass contiguous to the bottom of the tube, and that this ring raises the portions of fluid immediately below it, and then the other portions in succession, till the column thus elevated was in equilibrium with the attraction of the ring.

Clairaut had the honour of being the first mathematician who gave any thing like a theory of capillary attraction. After pointing out the insufficiency of preceding theories, he enters into an analysis of all the forces by which the fluid is suspended in the tube, of which we shall endeavour to give our readers a brief account. Let *ABCDEFGH*, *Fig. 7*, be the section of a ca-

pillary tube, MNP the surface of the water in the vessel, I i the height of its ascent, VIZ the concave surface of the fluid column, and IKLM an indefinitely small column of fluid reaching to the surface at M. Now the column ML is solicited by the force of gravity which acts through the whole extent of the column, and by the reciprocal attraction of the molecules, which, though they act the same in all the points of the column, only exhibit their effect towards the extremity M. If any particle e is taken at a less distance from the surface than the distance at which the attraction of the liquid generally terminates, and if mn is a plane parallel to MN, and at the same distance from the particle e , then this particle will be equally attracted by the water between the planes MN, mn . The water, however, below mn , will attract the particle downwards, and this effect will take place as far as the distance where the attraction ceases. The column IK, on the other hand, which is in a state of equilibrium with ML, is acted upon by the force of gravity through the whole extent of the column, also by other forces at the upper and lower extremities of the tube. The forces exerted at the upper part of the column, are the attraction of the tube upon the particles of water, and the reciprocal attraction of these particles; but as every particle is as much drawn upwards as downwards by the first of these forces, the consideration of it may be dropped. In order to estimate the other force, let a horizontal plane VX touch the concavity at I, a particle p , situated infinitely near to I, is attracted by all the particles above VX, and by all below it whose sphere of activity comprehends that particle; and as the particles above p are fewer than those below it, the result of these forces must be a force acting downwards. In order to estimate the value of the forces which act at the lower end O of the tube, let us suppose that the tube has a prolongation to the bottom of the vessel, formed of matter of the same density as the water. Let a particle R be situated a little above the extremity of the tube, and another Q as much below that extremity, they will be equally acted upon by the water above that place, and by the water between the fictitious prolongation of the tube, and therefore these forces will destroy one another. By applying to the case of the particle R the same reasoning that was used for the particle e , it will appear, that the result of its attraction by the tube is an attraction upwards. The particle R is likewise attracted downwards by the supposed prolongation of the tube, and the difference between these is the real effect. The other particle Q is also drawn upwards by the tube with the same force as R, since, by the hypothesis, it is as far distant from the points, D, G, as the particle R is from the points d, g , where, with respect to it, the real attraction of the tube commences. The particle Q is attracted also downwards, by the

supposed prolongation of the tube, and the difference of these actions is the real effect. Hence the double of this force is the sum of all the forces that act at the lower part of the tube. These forces, when combined with those exerted at the top of the tube, and with the force of gravity, give the total expression, which should be combined with that of the forces with which the column ML is actuated. Clairaut then observes, that there is an infinitude of possible laws of attraction which will give a sensible quantity for the elevation of the fluid above the level MN when the diameter of the tube is very small, and a quantity next to nothing when the diameter is considerable; and he remarks, that we may select the law which gives the inverse ratio between the diameter of the tube and the height of the liquid, conformable to Exp. 4.

The subject of capillary attraction was next taken up by Segner in 1751, who referred all the phenomena to the attraction of the superficial particles of the fluids. He deduces this principle from the doctrine of attraction. He supposes the attraction of the tube to be insensible at sensible distances; and he has shown that the curvature of each part of the surface of a fluid is proportional to its distance from the general level; and without much error, he has obtained from experiments the magnitude of this curvature at a given height both for water and mercury. M. Monge followed Segner in ascribing the capillary phenomena to the cohesive attraction of the superficial particles of the fluids; and he maintains that the surfaces must be formed into curves of the nature of linteariæ, resulting from the uniform tension of a surface resisting the pressure of a fluid, which is either uniform, or varies according to a given law.

In a very ingenious paper on the cohesion of fluids, read by Dr. Young in the Royal Society in 1805, that able mathematician gave a new theory of capillary attraction. He reduced all the phenomena of cohesion to the joint operation of a cohesive and a repulsive force, which balance each other in the internal parts of a fluid, where the particles are brought so near that the repulsion is exactly equal to the cohesive force by which they are attracted; and he assumed only, that the repulsion is more increased than the cohesion, by the mutual approach of the particles. More than a year after the publication of Dr. Young's paper, M. La Place published a Supplement to the '*Mecanique Celeste*,' upon capillary attraction, where he proposed a theory which led him to several conclusions that Dr. Young had already obtained by a more simple route. La Place supposes, from Exp. 11 and 18, that capillary action, like the refractive force, and the chemical affinities, is only sensible at imperceptible distances; that a narrow ring of glass immediately above the surface of the fluid, exerts its force on the water; and that this force, combined with the weight of the water and the

cohesion of its particles, produces the concave surface or *meniscus* of fluid with which the column is always terminated. He supposes this meniscus to be sustained by the action of the glass, while it exerts its own attraction on the fluid particles immediately below it, by means of which their gravity is diminished, and the water consequently rises in the tube; and he has determined the form of the meniscus to be that of a hemisphere, and its attraction to be equal to that of a spherule of water of the same diameter. Hence the attraction of the meniscus will be inversely as its diameter, or the diameter of the tube, that is, as the weight of the elevated column, and therefore the heights of ascent must be inversely as the diameter of the tube. "Since it has hitherto been usual with natural philosophers," says La Place, "to consider the concavity and convexity of the surfaces of fluids in capillary spaces, as a secondary effect of capillary attraction only, and not as the principal cause of phenomena of this kind, they have not attached much importance to the determination of the curvature of these surfaces. But the theory which has been here advanced, having shown that all these phenomena depend principally on the curvature, it becomes of consequence to examine it." In opposition to the authority of La Place, Professors Playfair and Brewster agree in thinking, "that the principal and primary cause is that attraction, which sustains the meniscus, and enables it to act on the water below without being drawn out of its place. It is not the concavity of its surface that makes the water in the tube press less in the bottom than if its surface were plain; but it is the attraction of the glass that produces in a manner equally direct, both the concavity and the diminution of pressure." The fact mentioned in Exp. 12, has been ascribed by La Place to the action of the drop upon the column, in consequence of its convexity; while Mr. Playfair supposes the additional elevation to be occasioned by the action of the bottom and outside of the tube upon the drop, by which the column of water is lifted up to a higher level. Mr. Brewster, however, thinks that the column of water, after being raised above its ordinary height in the tube, as in Exp. 12, is prevented from obeying the force of gravity by the force with which the drop below adheres to the bottom of the tube, and the force by which it resists any change of form; for the descent of the column to its usual height could only take place, either by detaching the drop altogether from the tube, or by giving it a more spherical, or a more elongated form. If the other explanations were true, then the column might be raised above its usual height in the tube, by placing a drop of water on the outside, and allowing it to descend to the bottom of the tube, where it would exert its force, according to La Place, or be acted upon by the tube, according to Mr. Playfair, which is not the case.—For further information on this

subject, see *Hooke's Micographia*.—*Hamilton's Lectures*, ii. p. 47.—*La Lande sur la cause de l'elevation des liqueurs*, Paris, 1770.—*Clairaut Theorie de la Figure de la Terre tirée des principes de l'Hydrostatique*, § 59.—*Dr. T. Young on the Cohesion of Fluids*, *Phil. Trans.* 1805; and in his *Nat. Phil.* ii. p. 649.—*La Place's Mecanique Celeste*.—*Playfair's Outlines of Nat. Phil.* vol. i. p. 176, 184.—*Report on the Theory of Capillary Attraction by Professor Challis, in British Association Report for 1831*.

CAPITAL. The stock of valuable exchangeable commodities possessed by individuals or a community. This is the usual and more limited meaning of the term; for, in comparing the capital of one individual with that of another, we have in mind the amount of money for which the stock of each can be exchanged,—the market-value is in view. In estimating the capital of any individual, we necessarily take into consideration the debts due to and from him; and many men of large capital are only possessed of claims upon others; their whole stock is in the hands of others at interest; and they have only promises for a certain amount of money, and actually possess neither lands nor goods to any considerable value; while others possess large quantities of both, and yet have little or no capital, since they owe, in money, the value of the greater part or the whole of their possessions. Now it is plain that no individual can undertake production, to any large extent, without an extensive stock. He must have land to cultivate, or materials to work up, and implements to work with. Even a savage must have a capital, such as his hut, clothes, cooking utensils, food enough to support him until he can obtain a new supply, and implements, such as a hatchet, gun, canoe, fishing gear, with which to procure this supply. The first effort of industry is to supply the implements, apparatus, and machinery for his own employment; and as society and the arts advance, and the operations of industry are extended, the implements, apparatus, machinery, and materials, requisite in conducting the processes of production, must be proportionally accumulated; and these will constitute a part of the capital of a community, and also of an individual, which is essential to success in productive processes. And these can be commanded by any one in proportion to the extent of his individual capital; or, if he have credit, then his resources for production will depend upon the capital of others—in other words, that of the community to which he belongs.

In considering the aggregate capital of a community, we may put out of the question all the debts due from any of the members to others; for, whether these be great or small,—and they will vary according as the practice of giving credit is more or less in use,—still the capital of the community will consist in its lands, buildings, ships, machinery, materials on hand, imple-

ments; in short, in all those things which bear a value in the market. Provided the community owes no debts abroad, these will constitute its aggregate capital; and, if its members are indebted abroad, we find its actual nett capital, as in the case of an individual, by deducting the amount of its debts from the value of its possessions, without regarding the debts due from some of its members to others.—In comparing the capital or wealth of two communities, we may be led into an error by comparing the value of their possessions in gold and silver, since the value of these metals is well known to differ in different countries, by whatever standard the comparison be made. If, for instance, we compare the value of the metals in reference to the wages of a common day-labourer, we find he has 2 or 3 pence a-day in Egypt, and from 50 to 72 pence in the United States. We shall find the same diversity in other things. If we take a horse, of the same beauty and serviceable qualities, for an example, we shall find his price, in money, to be twice as great in one place as in another. In order, therefore, to make such a comparison through the medium of the metals, or by adopting them as a common measure, we should, in the first place, correct the measure itself, and ascertain whether an ounce of gold, in one of the places between which the comparison is to be made, is worth a half of an ounce or an ounce and a half in the other; and the way of correcting the standard would be, to take equal quantities of a great number of articles of the same quality, in the two places, or equivalent quantities of equivalent articles, as nearly as their equivalence can be ascertained, and compare their money prices in the two places. But this correction of the common measure is not very easily made. The inhabitants are the great agents of production in every country; and, though their productive efficiency will be influenced, very essentially, by the amount of capital, fertility of the soil, quality of its products, facilities of transportation, and arrangements of industry, still the character, habits, and skill of the agents themselves, are the most important circumstances in estimating the productive resources of a community. Industry and skill will rapidly create capital. Mr. Phillips, in his *Manual of Political Economy*, estimates that the whole value of the capital of a country is consumed and reproduced every three or four years. But the training of a population, and forming its character and habits, is a work of many years. The most important ingredient in the national resources is, therefore, not only no part of its capital, but is a thing of very slow growth, and results from the combined and long-continued influence of a thousand causes, moral, physical, and political, too complicated to be disentangled, and so blended that the action of each cannot be distinctly traced. Economists have confined their views of production too much to consider-

ations of capital, and neglected, or, at least, not given sufficient weight to the other economical capacities and resources.

Capital is distinguished into *floating*, or *moveable*, and *fixed*; the former consisting of things that may be moved, and are susceptible of manual delivery; the latter, of those confined to one place, as a house or piece of land. We use the terms in a different sense when applied to any particular establishment, by the floating capital of which is meant that which remains after payment is made for all their apparatus and the implements of their business, and which is usually invested in the materials to be manufactured or transported, or to pass through the process, whatever it is, which constitutes the business conducted. Thus one carrying on a flour-mill wants a floating or disposable capital, over and above the cost of his works, to be invested in wheat and flour not yet disposed of. This instance illustrates what is meant by the floating or disposable capital of a whole community being that moveable, exchangeable stock of things on hand, over and above the fixtures and apparatus of production, including lands, buildings, ships, working animals, all the implements of the arts, with necessary food, clothing, and a stock of seed sufficient for the time requisite for reproduction. What remains over these is the disposable capital, and, in a flourishing community, the disposable floating capital is constantly invested in new fixed capital, implements and apparatus of production. A declining community, on the contrary, consumes a part of its implements and apparatus of industry, or, what is in effect the same thing, it does not repair and replace the damage of use and decay. The idea is held out in many economical treatises, that a community cannot have a surplus capital; that is, it cannot have more capital than it can make use of in its consumption and reproduction. As no grounds whatever are given for this doctrine, it seems to be hardly entitled to a consideration; for the position is certainly, at the first view, very improbable, since we know very well that men may accumulate; and why they may not, in any possible case, accumulate a surplus, does not appear by any plausible reason; and whether such surplus accumulation may be useful or not, will depend entirely upon the kind of articles of which such accumulation consists. If it consist in articles the value of which depends on the prices in foreign markets, the excess may be of no value at all; for it may so depress the foreign prices as to countervail all the indirect advantage arising from the cheaper supply, for a time, of the domestic demand.

Fictitious capital generally means nothing more nor less than excessive credits, which throw the management and disposition of a great deal of property into the hands of persons who are not able to answer for the risks of loss from its bad management, or other causes. A whole commu-

nity, in the aggregate, can have fictitious capital only in case of its members having an excessive credit in a foreign country. But the members may, among themselves, have a fictitious capital, by too great a facility of credits in their dealings with each other, and the fiction, in this case, is in their false promises of payment.

CAPIVI. See COPAIBA.

CAPON. A castrated male chicken. He is castrated as soon as he leaves the hen, or at least as soon as he begins to crow. Capons seem to have, at one time, been almost as common among the domestic poultry of our yards, as oxen are, at present, among the cattle of our fields; they appear, also, to have been universally regarded as superior to other chickens in at once size, good temper, and readiness to fatten; and they were regarded likewise as very serviceable for breeding chicks, ducklings, young turkeys, young pheasants, and young partridges, and as superior to the natural protectresses of these broods, both in conducting them to good feeding grounds, and in defending them against kites and buzzards. But many persons now regard capons as not a particle superior to other chickens; many view the probable advantages of them as not worth the trouble of castration; and many, who otherwise would be disposed to keep capons, either dislike to inflict the pain of castration, or cannot contrive to get the act performed.

CAPPARIS. See CAPER.

CAPPED HOCK. See CAPULET.

CAPRIFOLIUM. A genus of beautiful and fragrant plants, represented by the well-known woodbine or honeysuckle, and forming the type of the natural order Caprifoliaceæ. See the article HONEYSUCKLE. The name caprifolium means goat-leaf, and is a fanciful allusion to a supposed resemblance between the woodbine's and the goat's manner of climbing. The order Caprifoliaceæ comprises eleven genera, and has within the gardens and shrubberies of Britain nearly one hundred and twenty species. Most of the plants included in it possess great beauty or a large amount of other pleasing recommendations; and are either twining or erect shrubs, with cymes of white blossoms, or clusters of odoriferous yellow, white, or scarlet flowers. Some of the most widely diffused are the honeysuckles, the alder, the loniceras, the dogwoods, the viburnums, and the symphorias.

CAPSELLA. See SHEPHERD'S PURSE.

CAPSICUM. A genus of cultivated and pungent-fruited plants, of the nightshade tribe. Nearly thirty species are known to botanists, and upwards of twenty of these, besides some varieties, have been introduced to Great Britain from India, China, Egypt, South America, and the West Indies; and all, or very nearly all are cultivated in their native countries, and may be fruited in Great Britain, for the produce of their berries, the well-known cayenne pepper of commerce. About three-fourths of the introduced

species are evergreen, hothouse under-shrubs, of from one foot to four feet in height,—most of them carrying white flowers at some time between April and the latter part of July; and all the remainder are annual plants, of various degrees of tenderness or hardness.

The species called emphatically the annual, *Capsicum annuum*, appears to yield much more of the cayenne pepper of commerce than any other species. This is a native of both Indies, and was introduced to Britain about the middle of the 16th century. Its stem is herbaceous, smooth, roundish, crooked, branching, and from twelve to thirty inches in height; its leaves are smooth, ovate, entire, and stand on long, irregularly produced footstalks; its flowers are axillary, solitary, and white, and appear in June and July; and its fruit is a long, pendulous, two-celled, pod-like berry, sometimes of a yellow colour, but generally of a shining orange-scarlet.—The frutescent species, *Capsicum frutescens*, probably produces better cayenne pepper than any other of the East India species. It is cultivated in every part of Hindostan; and was introduced thence to Britain about the middle of the 17th century. It is an evergreen under-shrub, of about the same height as the annual species, and carries pale yellow flowers from June till September. A variety of it called the subtwisted, *C. f. torulosum*, carries white flowers, and grows to about twice the height of the normal plant, and was introduced to Britain from India in 1820.—The berried species, *Capsicum baccatum*, produces the best kind of cayenne pepper which arrives, ready prepared, in the ports of Britain. It grows only in the West Indies, and was introduced thence to Britain about 15 years ago. It is an under-shrub of three or four feet in height, and carries white flowers from June till September. Both the fruit of this species and that of the frutescent species is very commonly known in commerce under the name of bird pepper.—The large-fruited species, *Capsicum grossum*, is extensively grown in India for pickling, and was introduced to Britain about the middle of last century. It has the lowest growth of any in the genus, and, though an under-shrub, is only a biennial; and it carries white flowers, and blooms in July. Two varieties of it, the globe-fruited and the yellow-fruited, attain twice its own height, and are also cultivated in India. The fruit of this species has a more tender and fleshy skin than that of any other species, and is therefore eminently adapted for pickling. But the fruit of the hardier and more common species is extensively raised in Spain, Portugal, and the south of France, both to be eaten green, and to be pickled as a substitute for capers; and the fruit of many of the species and varieties is indiscriminately thrown together, or mixed up in India, to form inferior kinds of cayenne pepper.

The ripe fruit of the *Capsicum baccatum*, as

grown in the West Indies, is well dried in the sunshine, and then put into an earthen or stone pot, with a layer of flour alternating with each layer of fruit; and then baked in an oven till it is thoroughly freed from all interior moisture. The fruit is then separated from the flour, and ground into fine powder; a mixture is made of this powder and fine wheat flour, in the proportion of an ounce of the powder to a pound of the flour; the mixture is baked with leaven into small cakes; the cakes are cut into small pieces, baked again till they are as hard as biscuit, and then ground into powder and sifted; and the fine powder thus finally obtained is packed into closely-corked bottles, and sent to Britain as the best prepared cayenne pepper of commerce.—But the prepared pepper is often mixed with common salt, and sometimes with the very noxious pigment, red oxide of lead. To detect the presence of the latter ingredient, a decoction of a suspected specimen may be made with vinegar, and filtered; and, if red oxide of lead be present, the adding of some of the solution of sulphuretted hydrogen gas will throw down a black precipitate, or the adding of a proper proportion of sulphate of soda will throw down a white precipitate, which, when dried, and afterwards mixed with a little charcoal and heated, will evolve a globule of metallic lead.

Capsicum berries have an aromatic odour, and are extremely pungent, acrimonious and fiery tasted; and they communicate these properties to ether, alcohol, and water. But the odour is considerably dissipated by the process of drying; and the taste is much impaired and exceedingly diluted by conversion into prepared cayenne pepper. Either capsicum fruit itself, or cayenne pepper, or a tincture of capsicum is a powerful stimulant, and has been successfully employed in cases of dyspepsia, atonic gout, tympanites, paralysis, dropsy, cynanche, and scarlatina. The pepper is sometimes given, in the form of a ball, in doses of from twenty to thirty grains, to horses, for flatulency, indigestion, and cold; yet though a valuable stimulant, and though said to be a most efficient medicine in the veterinary practice of India, it is too heating, and makes too great an acceleration of the pulse.—*Ainslie's Materia Medica of Hindostan*.—*Thomson's London Dispensatory*.—*Miller's Dictionary*.—*Magazine of Domestic Economy*.—*Stevenson's Medical Botany*.—*Loudon's Hortus Britannicus*.—*White's Veterinary*.—*Youatt on the Horse*.

CAPSULE. A dry and membranaceous seed-cover. All capsules, when ripe, open in some determinate manner. Most are two-valved; but some, as those of the primrose plants, are one-valved; some, as those of the wood-sorrels, are many-valved; and some, as those of the ash-trees, have no valves.

CAPSULAR LIGAMENTS. The ligaments which, in large vertebrated animals, surround the ends of articulated bones, and form the joint

into a complete cavity. In the horse, they are long, thin, dense, and impervious, and serve both to strengthen the joint, and to resist dislocation; and though scarcely observable from the exterior, they secrete a peculiar mucus, are very vascular and sensitive, and, when injured, occasion very troublesome inflammation in the cavity of the joint. See the articles **JOINTS** and **WOUNDS**.

CAPULET, or CAPPED-HOCK. A wenny swelling or hursal enlargement on the heel of the horse's hock, or on the point of his elbow. It arises from bruises, kicks, and other causes, and has a great diversity of both appearance and character. When it is watery, or proceeds from indisposition of the blood, it ought not to be meddled with, but will, without aid, gradually wear away. When it has a thick consistency and a stubborn character, and yet appears to proceed from a bad state of the blood, it may be dispersed by a cautious use of repellers, rowels, purges, and diuretics. When it comprises great mucous secretion, and is accompanied with a thickening of the integuments, and has been caused or continues to be aggravated by kicking or other abrasion, it may be tried with vinegar or other repeller, and may next be repeatedly blistered, and may finally, if the case is very bad, be reduced by puncturing. But any use of the knife or the lancet requires extreme caution.

CARA. A cultivated variety of the yam,—*Dioscorea sativa*. It is called sometimes the cara of Brazil, and sometimes the cara of Rio de Janeiro. Its root is white-skinned, irregularly roundish, and superior in flavour to the tuber of any of the long-rooted varieties of the yam. It is extensively cultivated in the vicinity of Rio de Janeiro, and is generally preferred to the watery and bad-tasted potatoes which are usually raised for the Brazilian market. The name of cara is frequently given to other esculent roots of Brazil, particularly to *Jatropha manihot*.

CARAGANA. A genus of hardy ornamental shrubs and small trees, of the leguminous order. Sixteen species have been introduced to Britain; and twelve of these are natives of Siberia. Most of the species possess close resemblance to the acacia-tree, and five have, by many eminent botanists, been actually included in the acacia-tree genus. The arborescent species, *Caragana arborescens*—called by Linnæus *Robinia caragana*—was introduced to Britain from Siberia about the middle of last century. Its stem usually rises to the height of about fifteen feet; its branches are covered with a greenish-yellow bark; its leaves are abruptly pinnated, and consist each of about five or six pairs of oval, spear-shaped, pointed leaflets; its flowers grow on single footstalks from the sides of the branches, and are small and yellowish, and appear in April or May; and its pods are smooth and compressed, and ripen in September. An unarmed variety of the species, *C. a. inermis*, grows to only two-thirds of the height of the normal plant.—The

frutescent species, *C. frutescens*, formerly *Robinia frutescens*, was brought from Siberia about the same time as the arborescent species, and usually has a height of only about two feet. Its shoots are very tough and pliant, and are used by the Tartars for the same purpose for which osiers are used in England. Two varieties of this species, the one having broad leaflets and the other having narrow leaflets, *C. f. latifolia* and *C. f. angustifolia*, usually grow to the height of about six feet; and the latter was not long ago introduced from Odessa.—The thorny species, *Caragana spinosa*, was brought from Siberia in 1775. It grows to the height of six or seven feet, has long tough branches and large strong spines, and might be most advantageously employed in Britain for forming hedges which should combine great beauty with impenetrable thickness and remarkable strength.—The pigmy species, *Caragana pygmaea*, was brought from Siberia about the middle of last century, and usually grows to the height of only about a foot. Its wood has a deep bay colour, and is exceedingly hard. A recently introduced variety of it is called the Sandy Caragana, and is as low and feeble as the normal plant.—The silvery species, *Caragana argentea*—formerly called *Robinia Halodendron*, and recently constituted by the Russian botanist Fischer a separate genus, under the name of *Halimodendron argenteum*—was introduced from Siberia about the middle of the latter half of last century. It naturally grows on dry, barren salt-fields; and, probably in consequence of our soils being too rich and almost destitute of salt, it seldom flowers in our shrubberies or gardens. It usually grows to the height of about six feet, and is a very handsome shrub. Two varieties of it, *C. a. subvirescens* and *C. a. brachysema*, grow to the same height as the normal plant; and while all the other species of caragana carry yellow flowers, the several kinds of the silvery species carry purple flowers.

CARAMBOLA-TREE. See AVERROEA.

CARANDAS. See CARISSA.

CARAWAY. A small genus of hardy, biennial plants, of the umbelliferous family. It comprises only two species,—the common, *Carum carui*, which grows wild on the meadows and pastures of Britain,—and the simple-stemmed, *Carum simplex*, an uninteresting plant, which was introduced from Siberia in 1816. The common species is cultivated, for the sake of its seeds, in various parts of Essex and Suffolk. Its root is fusiform, or shaped like that of the carrot; its stem is smooth, channelled, branching, and between two and three feet in height; its leaves are smooth, doubly pinnate, and cut into narrow, linear, pointed, deep green segments or pinnulae; its flowers are five-petalled, whitish or pale blush, numerous, terminal, and generally in ten-rayed umbels; and its seeds are oblong, bent, brown, about a quarter of an inch long, and marked longitudinally with five straw-coloured ridges.

Caraway, being a biennial, is sown with coriander, or sometimes with corn, on the same principle on which clover is sown with barley; but in some instances, caraway, coriander, and teasel are all sown together on lea-land broken up for the purpose, and, when well-managed, make an exceedingly profitable return. The mode of cropping the three things together is described as follows by Mr. Sewell, of Maplestead, in Essex:—"About the beginning of March, plough some old pasture-land, the soil of which should be a very strong clay loam. Mix together ten pounds of coriander, twelve pounds of caraway, and twelve pounds of teasel seeds, which is sufficient for an acre; sow directly after the plough, and harrow the land well. When the plants appear of sufficient strength to bear the hoe—which will be in about ten weeks after the sowing—it must not be omitted; and in the course of the summer, it will require three hoeings, as well as one at Michaelmas. The coriander is fit to be cut about the beginning of July, and should be thrashed on a cloth like cole-seed. About the April following, your teasel and caraway will want a good hoeing, done deep and well, and another hoeing about the beginning of June. The caraway will be fit to cut the beginning of July, and must be thrashed in the same manner as the coriander. The teasel will not be ready till the middle of September; and some of the plants do not perfect their seeds until the third or fourth year, when those heads which are beginning to turn brown are cut off at the stem with a stalk a foot long. Of these, twenty-five are tied in a bunch; twenty-four of the bunches are fixed on a small stick, and called a row, twenty-four of which make a load, equal in bulk to about a ton of hay. The goodness of the crops must chiefly depend upon the care employed in their cultivation; and as the land can only be filled with plants, it is evident that the more one kind predominates, the less can be reasonably expected from those which succeed; accordingly the product of caraway is much greater without than with teasel." The caraway of the threefold crop, if soil and culture be good, may yield so much as a ton per acre, worth about £20; and both the caraway and the teasel, if kept in a clean and well-hoed condition, will make a profitable return, not only in the second year, but also in the third and the fourth, after sowing. But scarcely any soil will suit except such as is too rich in humus for corn; or rather, only a kind of soil will suit which an entire course of cropping with coriander, caraway, and teasel will simply reduce to a proper state of fertility for corn. The hoeing of caraway requires great attention, care, and labour, and is, in consequence, very expensive; and the gathering of the crop must be effected by a cautious cutting of the plants singularum, and depositing them one by one in a cloth, to be immediately carried to the thrashing floor. The proper garden culture of caraway

may easily be inferred from what we have said respecting the proper field culture.

Caraway seeds have a pleasant aromatic odour, and a sweetish, warm, pungent taste; they yield by distillation a volatile oil, which contains the whole of their aroma and active properties; they are extensively used by confectioners, in the manufacture of comfits, and by pastry-bakers in the preparation of fancy-breads; and they are employed, in medicine, to give warmth to cold purgatives, to dispel hysteria and flatulent colic, and to operate as a carminative and an axillary tonic. Not fewer than ten different preparations of them are ordered by the pharmacoposias. The seeds, especially in a state of powder, are much used in veterinary practice, as a carminative, a cordial, and an aromatic. They are, in any case of veterinary practice, second only to ginger as an aromatic; and in some cases, they are greatly preferable. But when caraway powder is purchased, careful examination of it ought to be made, lest it should prove to be only the worthless residuum of the still.—*Agricultural Survey of Essex*.—*Rham's Dictionary of the Farm*.—*Miller's Dictionary*.—*Mortimer's Husbandry*.—*Thomson's London Dispensatory*.—*Loudon's Hortus Britannicus*.—*Clater's Cattle Doctor*.—*Dunghisson's Materia Medica*.

CARBON. Charcoal, as we are familiar with it in common life, contains hydrogen, and saline, and metallic substances. Accordingly, it became necessary to introduce a peculiar term for its pure base, and the one adopted by chemists was *carbon*. This element, besides forming the inflammable matter of charcoal, exists largely in animal substances, and is extensively distributed in the mineral kingdom.

The only body in which carbon has been found to exist in a state of absolute purity, is the diamond. This precious stone has always been esteemed as the most valuable of the gems—a superiority which it owes to its hardness, lustre, and high refractive power. Diamonds are brought from India and from Brazil. Those of India, which have been the longest known, are principally found in the kingdoms of Golconda and of Visiapour. Those of Brazil, discovered at the commencement of the 17th century, belong to the district of Serro-do-Frio. The situations in which they occur are such as to favour the idea of their recent formation; since they exist disseminated through a loose, ferruginous sandstone, or quite detached in a sandy soil; and, in both cases, are situated at no great depth below the surface. In Brazil, the conglomerate in which they exist is called *cascalho*; from which they are extracted by washing, in the same manner as gold. The diamond uniformly occurs crystallized, and presents a great variety of forms; all of which yield readily to mechanical division parallel to all the planes of the regular octohedron, which, therefore, is the form of the primary crystal, and under which figure it is sometimes found in nature. The faces of its crystals are very fre-

quently curved, so as to communicate to them a rounded appearance. They are commonly limpid; and are either colourless, or of a yellowish, bluish, yellowish-brown, black-brown, Prussian blue or rose-red colour. Specific gravity, 3.5. Its hardness is extreme; so that it can be worn down only by rubbing one diamond against another, and is polished only by the finer diamond powder. The weight, and, consequently, the value of diamonds, are estimated in carats, one of which is equal to four grains; and the price of one diamond compared with that of another of equal colour, transparency, and purity, is as the squares of the respective weights. The average price of rough diamonds, that are worth working, is about £2 for the first carat. The value of a cut diamond is equal to that of a rough diamond of double weight, exclusive of the price of workmanship; and the whole cost of a wrought diamond of

1 carat may be about		£8
2 carats	is $2^2 \times$	£8 = 32
3 do.	is $3^2 \times$	8 = 72
4 do.	is $4^2 \times$	8 = 126
100 do.	is $100^2 \times$	8 = 80,000

This rule, however, is not extended to diamonds of more than 20 carats. The larger ones are disposed of at prices inferior to their value by that computation. The snow-white diamond is most prized by the jeweller. When transparent, and free from cracks, it is said to be of the *first water*.—The following are some of the most extraordinary diamonds known:—one in the possession of the Rajah of Mattan, in the island of Borneo, where it was found about a century ago: it is shaped like an egg, and is of the finest water: its weight is 367 carats, or 2 oz. 169 grs. Troy. Another is the celebrated Pitt diamond, now among the crown jewels of France, weighing 136 carats; another in the sceptre of the emperor of Russia, of the size of a pigeon's egg; and another in the possession of the Great Mogul, which is said to weigh 280, and which, in a rough state, weighed 793 carats.—From the fact that transparent inflammable bodies refract light in a ratio greater than their densities, Sir Isaac Newton conjectured that the diamond might consist of an unctuous matter coagulated. The Florentine academicians had rendered its combustibility probable, by exposing it to the solar rays of a powerful burning-glass, and observing that it gradually disappeared, or was consumed. Subsequent experiments settled the question, by proving, that the diamond lost none of its weight when calcined out of contact with the air; but, on the contrary, that it was dissipated when heated in contact with this fluid. It still remained, however, to be discovered, what was the true nature of the diamond. This was accomplished by Lavoisier, who enclosed diamonds in jars filled with atmospheric air or oxygen gas, and, after having caused them to disappear by the heat of a burning-glass, examined the air in

the vessels. He found it to exhibit precisely the same properties as the air which results from the combustion of charcoal. This experiment was also performed by Morveau, who demonstrated the nature of the diamond by still another arrangement. A diamond was enclosed in a cavity made in a piece of pure, soft iron; a stopper of the same metal was driven into it, and the mass was put into a small crucible, which was covered, and this into a second; the space between them being filled with pure silicious sand. The whole was exposed, for some time, to an intense heat. When examined, the diamond had disappeared, and the iron, with which it had been in contact, was converted into steel. Now steel is a compound of iron and carbon; and, as the diamond was not visible, and as there was no source from which the carbon could have been obtained, the conclusion was unavoidable, that the diamond was pure carbon. Yet so different is this mineral from charcoal, that it was, for a time, imagined that it contained some other element than carbon; but the numerous and delicate experiments of Sir H. Davy, and several other chemists, failed of detecting any thing else in its composition; and, although there exists so great a difference between the diamond and charcoal, in their external properties, we are forced to believe that they are identically of the same nature. The diamond is, therefore, pure carbon, and differs from charcoal (leaving out of question its trifling impurities) only in the arrangement of its molecules.

The substance in which carbon exists next in purity is charcoal. For common purposes, this is prepared by piling billets of wood in a pyramidal form, with vacuities between them for the admission of air, covering them with earth, and inflaming them. In consequence of the heat, part of the combustible substance is consumed, part is volatilized, together with a portion of water, and there remains behind the ligneous fibre only of the wood, in the form of a black, brittle, and porous body. When required pure, and in small quantities, for the purposes of the chemist, it may be obtained by immersing the wood in sand contained in a crucible exposed to heat. According to the experiments of Messrs. Allen and Pepys, the weight of charcoal obtained from 100 parts of different woods was as follows:—fir, 18·17; lignum vitæ, 17·25; box, 20·25; beech, 15; oak, 17·40; mahogany, 15·75.

Lampblack is charcoal in a state of minute division, and is prepared for the demands of trade from the dregs which remain after the eliquation of pitch, or else from small pieces of fir-wood which are burned in furnaces of a peculiar construction, the smoke of which is made to pass through a long horizontal flue, terminating in a close, boarded chamber. The roof of this chamber is made of coarse cloth, through which the current of air escapes, while the soot, or lampblack remains behind.—*Coke* is a peculiar kind of

charcoal, which remains in the retort, after the heating of coal to procure the coal gas.—*Ivory-black*, or *animal charcoal*, is obtained from bones made red-hot in a covered crucible, and consists of charcoal mixed with the earthy matters of the bone.—Wood charcoal, well prepared, is of a deep-black colour, brittle, and porous, tasteless and inodorous. It is infusible in any heat a furnace can raise; but, by the intense heat of a powerful galvanic apparatus, it is hardened, and at length is volatilized, presenting a surface with a distinct appearance of having undergone fusion. The density of charcoal, according to Mr. Leslie, is little short of that of the diamond itself, although its specific gravity has usually been considered as low as 2·00. Charcoal is insoluble in water, and is not affected by it at low temperatures; hence wooden stakes, which are to be immersed in water, are often charred to preserve them.—Owing to its peculiarly porous texture, charcoal possesses the property of absorbing a large quantity of air, or other gases, at common temperatures, and of yielding the greater part of them when heated. It appears, from the researches of Saussure, that different gases are absorbed by it in different proportions. He found that charcoal prepared from box-wood absorbs, during the space of 24 or 36 hours, of

Ammoniacal gas,	90 times its volume;
Muriatic acid, .	85 do.
Carbonic acid, .	35 do.
Oxygen, . .	9·25 do.
Hydrogen, . .	1·75 do.

Charcoal likewise absorbs the odoriferous and colouring principles of most animal and vegetable substances. Thus, all saline substances, which, from the adherence of vegetable or animal extractive matter, are of a brown colour,—as crude tartar, crude nitre, impure carbonate of ammonia, and other salts, may, after being digested through the medium of water with charcoal, be obtained white by a second crystallization. Resins, gum-resins, assafœtida, opium, balsams, essential oils, and many other substances, even those that have the strongest smell, are rendered nearly inodorous when they are rubbed with charcoal and water, or when solutions of them in alcohol are macerated with the charcoal, or filtrated repeatedly through it. A number of the vegetable tinctures and infusions also lose their colour, smell, and much of their taste, by the same process. Common vinegar, on being boiled with charcoal powder, becomes colourless. Malt spirit, by distillation with charcoal, is freed from its disagreeable flavour. In the same manner wines, also, become colourless, and distilled waters lose their odours. Water, which, from having been long kept in wooden vessels, as during long voyages, has acquired an offensive smell, is deprived of it by filtration through charcoal powder, or even by agitation with it for a few minutes, especially when a few drops of sulphuric acid have also been added. Hence, also, it has

been found that, by charring the inside of casks for keeping water, it may be preserved a long time without spoiling. Charcoal can even remove or prevent the putrescence of animal matter. If a piece of flesh has become tainted, the taste and smell may, in a great measure, be removed, by rubbing it with charcoal powder; and it may be preserved fresh for some time by burying it in the same substance. To produce these effects, however, it is necessary that the charcoal should have been well calcined and newly prepared.—The uses of charcoal are extensive. It is used as fuel in various arts, where a strong heat is required without smoke, as in dyeing, and in various metallurgic operations. By cementation with charcoal, iron is converted into steel. It is used in the manufacture of gunpowder, in its finer state of aggregation, under the form of ivory-black, lamp-black, &c. It is the basis of black paint; and, mixed with fat oils and resinous matter, to give a due consistence, it forms the composition of printing ink. It is used to destroy colour and odour, particularly in syrups; to purify honey; to resist putrefaction; to confine heat, and for a number of other important purposes.—When charcoal is heated to a certain degree in the open air, or in oxygen gas, it takes fire, and burns with the production of an elastic vapour, which has been called CARBONIC ACID GAS. See that article.

CARBONATES. Salts consisting of carbonic acid in combination with alkaline or metallic bases. They are attacked and decomposed by nearly all other acids than their own; and while undergoing decomposition, or sending off their carbonic acid into the atmosphere, and surrendering their bases to the attacking acids, they exhibit the beautiful phenomenon of effervescence. The carbonates of lime and magnesia are deprived of their carbonic acid, and reduced to a caustic, or, in old chemical language, a calcined state, by the application of a full red heat; the carbonates of baryta and strontia are decomposed by an intense white heat; the carbonates of soda, potash, and lithia, cannot be decomposed by mere heat; and all the other carbonates are deprived of their carbonic acid by a dull red heat. All the carbonates are more or less affected by an excess of carbonic acid, so as to imbibe more of it and form supercarbonates; and all, excepting those of soda, potash, and ammonia, are very sparingly soluble in pure water. The carbonates of lime, magnesia, strontia, baryta, soda, and manganese, and the double carbonate of lime and magnesia, are found naturally existing; but most of the others are formed by artificial processes, or with some artificial aids.

Some of the carbonates, particularly those of lime, magnesia, soda, potash, iron, and manganese, play a very prominent part as constituents of soil, either natural or added; but they will be noticed, as to their individual nature and their respective modes of action, in the articles **LIME**,

MAGNESIA, **SODA**, **POTASH**, **IRON**, and **MANGANESE**. The carbonate of ammonia contained in rain water also performs most important functions in the feeding of vegetables, and consequently in the chemical processes of a farm. See the article **AMMONIA**. Several of the carbonates—especially those of lime, soda, potash, and magnesia—besides acting directly, as constituents of soil, upon plants or upon their food, perform the great offices, jointly with the carbonic acid of the atmosphere, of attacking and reducing the silicates, which, but for their action, would form an ingredient of soil as stationary and unyielding as it is widely diffused and bulky. “The silicic acid,” remarks Dr. Dana, “acts on the lime, forming silicate of lime; while the carbonic acid, now let loose, acts as such upon other silicates, and eliminates or frees the alkaline bases. Let it be supposed that there is silicate of alumina, that is clay, or silicate of potash and alumina, in the soil. Let carbonate of lime, that is marble, and slacked lime, shells, &c., be added to the soil. The result is that, slowly but surely, chemical action takes place, the silicic acid pulling one way, and the carbonic acid another, the lime is changed to silicate of lime, and the carbonic acid escapes, and now in its turn acts upon silicates as did carbonic acid of air. The alumina remains, the soil becomes more clayey. Thus sands by liming are amended. This principle of the action of carbonates, unravels the mysterious action of a vast variety of substances, which appear to be very inert and inefficient. It must be remembered, that the action of silicates and salts is alone under consideration, uninfluenced by the presence of geine or plants. That action in its simplest form constitutes the following, which may be laid down as the ninth principle of agricultural chemistry,—carbonic acid and the carbonates decompose the earthy, alkaline, and metallic silicates of soil.” — *Turner's Elements of Chemistry*.—*Liebig's Chemistry of Agriculture*.—*Johnson's Lectures on Agricultural Chemistry*.—*Dr. Dana's Muck Manual*.—*Chaptal's Chemistry applied to Agriculture*.

CARBONIC ACID. A colourless, inodorous, elastic fluid, consisting of one equivalent of carbon and two equivalents of oxygen. It possesses, in an eminent degree, all the physical properties of the gases, and cannot be condensed into a liquid under a less pressure than one of thirty-six atmospheres. It consists, by volume, of equal volumes of carbon vapour and oxygen gas; and, by weight, of six parts of carbon and sixteen of oxygen. Its specific gravity is estimated by Dulong and Berzelius at 1.524, and by Dr. Thomson at 1.5277; so that, according to the latter estimate, 100 cubic inches of it weigh 47.377 grains.

Carbonic acid was discovered, in 1757, by Dr. Black; and was, for a considerable time afterwards, known under the name of fixed air. Its composition was first demonstrated synthetically

by Lavoisier, and analytically by Mr. Smithson Tennant. Lavoisier burned carbon in oxygen, and obtained carbonic acid from the combustion; and Mr. Tennant passed phosphorus vapour over carbonate of lime heated to redness, and found that, in consequence of the phosphorus abstracting the oxygen from the carbonate, and forming phosphoric acid, and in consequence of the phosphoric acid thus formed combining with the lime to constitute phosphate of lime, the carbon or charcoal of the carbonate was deposited, in a separate state, in the form of a light black powder. Carbonic acid is very readily obtained, for the purposes of experiment or of separate examination, by the action of almost any of the acids upon chalk or bruised marble; for almost any other acid, particularly the hydrochloric, the nitric, or the sulphuric, rapidly abstracts the lime of the carbonate, and allows the carbonic acid to escape by effervescence.

Carbonic acid cannot be made to burn or to combine with oxygen; and it will neither maintain combustion nor support respiration, but, on the contrary, is both extinctive of flame, and destructive of breathing. So great is its extinguishing power upon combustion, that a mixture of one volume of it with four volumes of atmospheric air will prevent a candle from igniting, or extinguish the flame of a candle already burning; and so great is its destructive power upon respiration, that a quantity of it not quite sufficient to extinguish the flame of a candle will deprive an animal of sensibility, and a quantity just sufficient to extinguish flame will produce almost instant death. When air contains a large proportion of carbonic acid, it violently contracts the glottis, and cannot even enter the lungs; and when it contains only so moderate a proportion as to obtain entrance to the lungs, it operates as a narcotic poison. A large proportion of carbonic acid in atmospheric air constitutes the choke damp of coal mines, deep wells, and brewers' vats, which has, in such multitudes of instances, proved rapidly or instantaneously fatal to man; and a comparatively small proportion of it, from the combustion of charcoal in rooms, crowded respiration in cells or close apartments, and the eremacausis of vegetable matter in fens and marshes, constitutes all or most of the poisonous air which, in so many thousands of instances, has embittered, shortened, or destroyed human life. Yet, though injurious or fatal when received into the lungs, it is innocuous and exhilarating when received, in moderate proportion, into the stomach. It is held in solution, to a greater or less degree, by all fountain and river water; it gives to all such water the agreeable gout which distinguishes it from the insipidity, staleness, and disagreeableness of distilled water or of recently boiled water; it constitutes the whole of the sparkling, brisk, and sharply racy property of soda water and of the other aerated waters of the manufacturing chemist;

and it imparts to cider, ginger beer, ale, porter, beer, and brisk champaign, the greater portion of the agreeable pungency, which renders them so highly relishable, and the loss of which, by exposure to the air, occasions them to become stale.

Carbonic acid abounds in the waters of many mineral springs, such as those of Tunbridge, Pyrmont, and Carlsbad; it issues directly from the fissures of rocks, caves, and mines, in many countries, particularly in the vicinity of volcanoes; it accumulates at the bottom of wells, and in the recesses of pits and mines, where decomposition of carbonates or of organic substances extensively proceeds without free communication with the open air; it is evolved in vast volumes or in constant streams from stagnant fermentations and putrefactions in fens, marshes, and close forests; and, in all such situations, it is liable to exert a most poisonous power upon the local atmosphere, or to form, in the recesses or at the surface of the earth, exceedingly noxious aerial mixtures. Yet, excepting in such situations, it nowhere exists in such quantity as to be, in even the slightest degree, detrimental to animal health and energy. It rises into the atmosphere, in enormous aggregate quantities, from the combustion of all substances containing carbon, from the eremacausis and the destructive fermentation of all vegetable substances, from the respiration of all animals, and from the putrefactive decay of all organic matter; for it is formed, in combustion, by the combination of the carbon of the burning body with the oxygen of the atmosphere,—in eremacausis, by the resolution of the whole substance of decaying vegetables into its elements, and the recombination of these into simpler and more attenuated forms,—in destructive fermentation, by the loss of oxygen and carbon, during the transmutation of one ternate substance into another,—in the respiration of animals, by the combination of the superfluous carbon of the blood with the oxygen of decomposed water, or with the oxygen of the atmosphere, or with both,—and in the putrefactive decay of all animal matter, by a transposition of its elements or a disturbance of its attractions, such as involves the conjoint or simultaneous evolution of carbon and oxygen in the form of carbonic acid, hydrogen and oxygen in the form of watery vapour, and hydrogen and nitrogen in the form of ammonia. Yet though the quantity of carbonic acid constantly poured from these sources into the atmosphere is great, and though all carbonic acid is heavier than atmospheric air, the proportion of it relatively to the other constituents of the atmosphere does not experience any observable variation from season to season, or from year to year, and the relative quantity of it, though affected by drought or frost, by light or darkness, and by luxuriance or sterility, is exactly or very nearly the same in the higher regions as in

the lower, or at the summit of the loftiest mountains as at the surface of well-cultivated and thoroughly-ventilated plains. The former of these seeming anomalies is accounted for by the fact of all vegetables assimilating the carbon of carbonic acid, and giving back its oxygen to the atmosphere; and the latter is explained by the well known tendency of gases to make equal diffusions throughout one another without reference to their respective gravity. See the articles *ATMOSPHERE*, *AGRICULTURAL CHEMISTRY*, and *VEGETABLE PHYSIOLOGY*.

The average proportion of carbonic acid in the atmosphere is usually stated, in round numbers, at a thousandth part; but according to the most exact and most recent experiments, it is $\frac{1}{1000415}$ th of the atmosphere's own volume. "We have reason to believe," says Liebig, "that this proportion was much greater in past ages; and, nevertheless, the immense masses of carbonic acid which annually flow into the atmosphere from so many causes, ought perceptibly to increase its quantity from year to year. But we find that all earlier observers describe its volume as from one-half to ten times greater than that which it has at the present time; so that we can hence at most conclude that it has diminished. It is quite evident that the invariable quantities of carbonic acid and oxygen in the atmosphere, must stand in some fixed relation to one another; a cause must exist which prevents the increase of carbonic acid by removing that which is constantly forming; and there must be some means of replacing the oxygen removed from the air by the processes of combustion and putrefaction, as well as by the respiration of animals. Both these causes are united in the process of vegetable life.

* * * The various layers of wood and mineral coal, as well as peat, form the remains of a primeval vegetation. The carbon contained in them must have been originally in the atmosphere as carbonic acid, in which form it was assimilated by the plants which constitute these formations. It follows from this that the atmosphere must be richer in oxygen at the present time than in former periods of the earth's history. The increase must be exactly equal in volume to the carbonic acid extracted in the nourishment of a former vegetation, and must, therefore, correspond to the quantity of carbon and hydrogen contained in the carboniferous deposit. Thus, by the deposition of ten cubic feet Hessian (5.51 cubic feet English) of Newcastle splint coal, (of the formula $C_{24}H_{13}O$, and specific gravity 1.226), the atmosphere must have been deprived of above 18,000 cubic feet Hessian (9,918 cubic feet English) of carbonic acid, and must have been enriched with the same quantity of oxygen. A further quantity of oxygen, amounting to 4,480 cubic feet Hessian (2,468 English) must have been furnished to the air by the decomposition of water, for ten cubic feet Hessian of coal contains hydrogen corresponding to this amount.

In former ages, therefore, the atmosphere must have contained less oxygen, but a much larger proportion of carbonic acid, than it does at the present time; a circumstance which accounts for the richness and luxuriance of the earlier vegetation. When this became entombed, higher forms of animal life were capable of existing. But a certain period must have arrived in which the quantity of carbonic acid contained in the air experienced neither increase nor diminution in any appreciable quantity. For if it received an additional quantity to its usual proportion, an increased vegetation would be the natural consequence, and the excess would thus be speedily removed. And, on the other hand, if the gas was less than the normal quantity, the progress of vegetation would be retarded, and the proportion would soon attain its proper standard. When man appeared on the earth, the air was rendered constant in its composition."

The fact that plants assimilate the carbon of carbonic acid, and return its oxygen to the atmosphere, was ascertained by Priestley and Senebier, and established by Percival and De Saussure; and it has been tested and illustrated by multitudes of more modern chemists and phytologists, and may be ascertained, to his perfect satisfaction, by any ordinary intelligent observer. The leaves and other green parts of a plant absorb carbonic acid and emit an equal volume of oxygen, even independently of their connexion with the stem and root; for if they be detached from the rest of the plant, and placed in water which contains carbonic acid, and then exposed to a play of sunshine, they will speedily be found to deprive the water of all its carbonic acid; and if the experiment be conducted under a glass receiver filled with water, the oxygen which they evolve from the absorbed and decomposed acid, may be collected and examined. But if the same leaves, or others precisely similar, be placed, under a glass receiver, in water which does not contain carbonic acid, or in water which, while containing it, contains also such an alkali as resists its assimilation, no oxygen whatever will be evolved. Sir Humphrey Davy placed a piece of turf, four inches square, in a porcelain dish which floated on the surface of water impregnated with carbonic acid; he covered the turf with a glass vessel of 230 cubic inches in capacity; he occasionally supplied this vessel with water, through a funnel furnished with a stopcock; he daily supplied the water in which the porcelain dish floated, with new water saturated with carbonic acid, so as to cause a small quantity of the acid to be constantly present in the receiver; and he found that—in consequence of the action of the grasses of the turf upon the carbonic acid thus fully and steadily supplied to them in the water—the air in the receiver acquired, in the course of eight days, an increase of thirty cubic inches to its volume, and of four per cent. to its proportion of oxygen. Ditches, pools, and small lakes,

whose bottoms are covered with growing plants, afford to every eye a familiar and most satisfactory illustration of the same phenomenon. When these little sheets of water are so completely frozen over as to have no communication with the atmosphere, small globules of gas are observed to escape, in rapid succession, from the points of the leaves and twigs, and to accumulate under the ice till they form large bubbles; and these bubbles steadily increase in volume so long as the ice remains unbroken, and are found to consist of pure oxygen,—the plants which form them obviously absorbing the carbonic acid held in solution in the water, resolving it into its elements, assimilating the carbon, and liberating the oxygen.

Just as these illustrations, and a thousand more, evince that plants absorb and decompose the carbonic acid of water; so do other and quite as clear illustrations evince that they absorb and decompose the carbonic acid of the atmosphere. One of these—an experiment of De Saussure—not only proves the fact of the absorption of aerial carbonic acid, but at the same time shows the highest proportion of it in atmospheric air which is capable of assimilation or of healthy action. “De Saussure, having taken a number of young plants of pease, of about the weight of twenty grains each, he immersed them by the root in glasses filled with water. Thus conditioned, he next introduced them into receivers exposed to the direct rays of the sun, and filled some with common air, and some with different mixtures of common air and carbonic acid gas. In an atmosphere of common air, exposed during ten days to the sun, they were found to have increased their weight by eight grains. In an atmosphere of pure carbonic acid gas, they faded and withered away, without any farther development. In an atmosphere containing three-fourths of carbonic acid gas, they withered also. But if containing only one half, they lived seven days; if but one quarter, ten days, augmenting their weight by five grains; and if containing only one-twelfth of carbonic acid gas, they increased their weight by eleven grains. This was the maximum of its beneficial application.” Many and most accurate experiments have been conducted with plants artificially placed in soil destitute of carbon, and observations made upon plants naturally growing on sands and rocks almost destitute of humus; and they have ascertained, to a demonstration that the carbon constituting the great proportion of the plants’ substance, and the acquisition and fixing of which is the chief process of their growth, could not possibly have been obtained elsewhere than from the carbonic acid of the atmosphere, partly carried down to the roots in water, but principally or almost wholly absorbed, in its aeriform condition, by the leaves and the green portions of the stem and branches.

By another and very numerous set of experiments and observations, plants have been ascer-

tained to absorb carbonic acid and assimilate its carbon, only during the presence of light,—to be capable of absorbing any proportion artificially added to the natural quantity in the atmosphere, only during the play of sunshine,—to assimilate the carbon of such as is taken up by the roots, only when it ascends with the sap to the leaf,—and to be incapable of absorbing any from the atmosphere during the darkness of night, but, on the contrary, to give out, during that time, a small proportion into the atmosphere. An opinion very generally prevails, and was not long ago all but universal, that the assimilation of the carbon of carbonic acid, in any circumstances, is effected only during the play of sunshine, and cannot be effected in diffused light; but this is altogether an error. “Exactly the same constituents,” remarks Liebig, “are generated in a number of plants, whether the direct rays of the sun fall on them, or whether they grow in the shade. They require light, and indeed sun-light, but it is not necessary that the direct rays of the sun should reach them. Their functions certainly proceed with greater intensity and rapidity in sunshine than in the diffused light of day; but there is nothing more in this than the similar action which light exercises on ordinary chemical combinations; it merely accelerates, in a greater or less degree, the action already subsisting.”

The absorption of the carbonic acid of water by the leaves of aquatic plants growing under water, and the absorption of the carbonic acid of the atmosphere by the leaves of land plants growing in the air, are processes apparently different, but really the same. The tissues of leaves and other parts in the air are saturated with water, either brought up to them in the form of ascending sap from the spongioles, or directly imbibed by them from the rains of the atmosphere or from the nightly depositions of dew; and, being penetrated and moistened with this water in every part of their succulent structure, they do not inhale the carbonic acid atmosphere as a gas, but receive it into solution with this saturating moisture, and, in consequence, absorb it in exactly the same form, and dispose of it by exactly the same process of assimilation, as the leaves of submerged aquatics do to the carbonic acid of water. The only actual difference between the two classes of plants regards, not at all their behaviour with carbonic acid when supplied to them, but merely the outward and extraneous contrivance for affording them supplies; and this, in very many instances, furnishes a beautiful illustration of the all-pervading care with which the Divine Being provides for the wants and the mutual adaptations of even his inorganic and his unanimated creatures. In the case of aquatic plants, which grow wholly submerged and are fixed to one spot, currents of water are established by variations of specific gravity to bring them a constant supply of their principal food; so that as soon as one portion of

water has approached them, and surrendered its carbonic acid to their leaves, it is driven away by the pressure of other portions, which are approaching to perform the same duty. But in the case of aerial plants, the leaves unfold a broad surface to the atmosphere, and readily, by reason of the darkness of their colour, absorb the caloric rays descending upon them, and in consequence establish and maintain a warm current for the constant withdrawal of expended air and the constant approach of carbonaceous air; in multitudes of instances also, the sensitive and waving leaves stand upon slender footstalks, and give way to the slightest motion in the atmosphere, and are hence brought continually into extensive and ever-changing volumes of carbonic acid; and in all instances, winds more or less prevail, to sweep away expended portions of the atmosphere, and bring fresh supplies of carbonaceous portions, or to mix the air of the seas and the deserts with that of the land and the fertile regions, and to make the carbonaceous air of the middle strata of the atmosphere exchange places with the oxygenous air of the lower strata. An animal, whose chemical task is oxidizement, is provided with instincts and locomotive powers to go in search of his food; but a plant, whose chemical task is the more delicate one of carbonizement, or of reversing the effects of the animal's task, and of maintaining a fair balance of chemical forces in the momentous relations of the atmosphere to the organic world, obtains a supply of all its wants by means of exquisite and ever-operating exterior contrivances of the all-wise and all-benevolent Creator.

"But in what state," asks Keith, "is the carbonic acid actually assimilated to the plant? Is it assimilated in the state in which it is inhaled, or is it previously decomposed? It had been observed by Ingenhouthz that the leaves of plants, if placed in water and exposed to the action of the sun's rays, will evolve a quantity of oxygen gas. It was afterwards ascertained by Senebier, that this process takes place only when the leaves are fresh, and the water impregnated with carbonic acid. For when the water was deprived of its carbonic acid by boiling, or in the course of experiment, there was no more oxygen evolved. But when the water was again impregnated with carbonic acid, the extrication of oxygen recommenced as before. Thus, the conclusion is obvious, and the phenomenon satisfactorily accounted for;—the carbonic acid gas contained in the water is abstracted and inhaled by the leaf, and immediately decomposed; the carbon being assimilated to the substance of the plant, and the oxygen evolved. Yet in the process of the fixation of carbon, there seems, according to Saussure, to be also a partial fixation of oxygen, as well as the disengagement of a portion of nitrogen, of which the origin is a matter of doubt. Has it entered the plant with the air of the atmosphere, or mingled with carbonic acid, or with ani-

mal substances soluble in the moisture of the soil?"

A question, implying a doubt, has been raised, whether a possibility exists of all plants obtaining their carbon from the atmosphere, or, in other words, whether a sufficiency of carbonic acid exists in the atmosphere for their supply. But this question can easily and most satisfactorily be settled by a brief calculation. A column of air of 2,517 lbs. weight rests upon every square foot of the surface of the earth; a thousandth part of this is carbonic acid; and twenty-seven per cent. of carbonic acid is carbon. Now a calculation on these data, jointly with the known diameter and superficies of the world, will show that so vast a quantity as 3,085 billions of pounds of carbon is contained in the atmosphere,—a quantity greater than that existing in a solid form, whether in living plants or in all the strata of mineral and brown coal throughout the earth; and this quantity—especially as the supply of it from respiration, combustion, fermentation, eremacausis, and putrefaction, is maintained undiminished—cannot but be most ample for the supply of all vegetation. The solicitude of all agriculturists of the old school, to afford their crops a supply of carbon in the form of humus or of decayed vegetable fibre in the soil, therefore, was an idle waste of thought, and occasioned a perfectly gratuitous expenditure of labour. The manuring of land, as is shown in many of our articles, ought always to have reference to the supply of elements far different from carbon. See the articles MANURES, ALKALIES, AMMONIA, CHARCOAL, and many others.

Carbonic acid has been proposed as at once an easy, an effective, and a very economical means of destroying the red spider and the other insects which infest plant-houses; but to prevent risk to the life or health of the gardener, it requires to be administered and dissipated in some manner which will protect him from breathing it; and to prevent damage to the plants, it ought to be administered under a play of clear sunshine, when their power of absorbing it is at a maximum. One proposed method of applying it is to generate it in a separate building, and to pump it, through an orifice, into the top of the plant-house, by means of a syringe or an engine hose; and another and far simpler and more economical method, is to spread a four-inch stratum of powdered chalk on the floor of the plant-house, and, by means of a garden or vinery engine, with its rose introduced through a pane, to let down upon it a sufficient shower of diluted sulphuric acid, to effect its thorough effervescence, and the consequent extrication of all its carbonic acid. A coincident advantage of this latter method is to transmute the chalk into gypsum, and render it fit to be used as a field manure.—*Turner's Elements of Chemistry.*—*Draper's Chemistry of Plants.*—*Davy's Agricultural Chemistry.*—*Liebig's Chemistry of Agriculture.*—

Keith's Botanical Lexicon.—*Johnson's Lectures on Agricultural Chemistry.*—*Dr. Madden's Papers in Quarterly Journal of Agriculture.*—*Chaptal's Chemistry applied to Agriculture.*—*The Gardener's Gazette.*

CARCASS, or **CARCASE**. The technical and collective name of the ribs, belly, and flanks of the horse.

CARDAMINE. See **LADIES' SMOCK**.

CARDAMOM,—botanically *Alpinia cardamomum*. An officinal and ornamental hothouse plant, of the order Scitamineæ. It grows wild, and is cultivated, in India; and was introduced thence to Britain in 1815. Its root is an oblong, jointed, whitish tuber; its stems are reed-like, round, smooth, half an inch thick, and from eight to twelve feet high; its leaves are alternate, sheathing, green, broad, from four inches to two feet long, and strongly aromatic and subacid in both taste and odour; its flowers are produced in racemes from the underground stem, and creep along the ground, and have a whitish-purple colour, and appear in August; and its capsule is smooth and fleshy, and contains from eighteen to twenty-seven seeds. The cultivated plants do not flower till their fourth year; and their ripe capsules are gathered in November, and dried either in the sunshine or over a slow and gentle fire. The seeds are very extensively used in India for mixing up with the areca-nut and for flavouring ragouts; and are produced, in large quantities, for exportation to Britain. About 60,000 pounds are collected annually on the Malabar coast; and proportionally great quantities are produced in some other continental districts, and in the island of Ceylon. They have a warm spicy taste, and a very agreeable though pungent aromatic odour; and they readily surrender all their properties to ether or to alcohol. They are less stimulating than pepper, and act as gentle carminatives and tonics; but are used, in human medicine, principally as a heating ingredient in stomachic mixtures,—and, in veterinary practice, almost wholly as a cordial. No fewer than fifteen of the preparations ordered by the pharmacopœias have cardamom as one of their ingredients.

The plant which we have described is the only one which yields the true cardamom of commerce; but several other species of the order Scitamineæ produce seeds of kindred though inferior properties, and are not infrequently confounded with this plant, in some instances by knavery, and in others by mere ignorance. The mediate alpinia, *Alpinia media*, growing to three-fourths of the height of the true cardamom plant, and producing red flowers in July and August, is sometimes called the middle cardamom. The cardamous amomum, *Amomum cardamomum*, growing to half the height of the true cardamom plant, and producing pale brown flowers in May and June, is very generally called the small or lesser cardamom. The grain of paradise plant.

also, and even all the species of the genus *amomum*, are occasionally regarded as cardamom plants.

CARDIAC. See **MOTHERWORT**.

CARDITIS. Inflammation of the heart. It sometimes occurs in the horse; and may possibly be relieved by appliances for promoting absorption; but, in general, it must be regarded as hopeless.

CARDOON, or **CHARDON**,—botanically *Cynara cardunculus*. A cultivated, culinary, perennial plant, of the artichoke genus. It is a native of Candia, and was introduced thence to Britain about the middle of the 17th century. It possesses a somewhat close resemblance to the common garden artichoke, and has been regarded by some botanists as a hybrid of it; but it bears decided marks of being a perfectly distinct species. It usually grows to the height of about five feet; and it carries purplish blue composite flowers in August and September. Its florets were formerly used by the Portuguese for coagulating milk, in the same manner in which rennet is used in Britain; and the large, fleshy, tender, stems of its inner leaves, blanched and rendered crisp by earthing up, are used, during winter in Britain, for stewing, and for soups and salads.

Cardoon is sown in March, in a bed of light soil, exactly such as is suitable for artichoke. When the plants come up too close, they should be thinned; and, when an early supply is wanted, the plants thinned out may be transplanted into a nursery bed, at distances from one another of three or four inches, there to remain, and to be kept perfectly free from weeds, till ready for final transplanting; and in June, they may be removed to a piece of moist, rich, well-prepared ground, there to grow to maturity, and to yield their produce. They must be well watered till they take root; they must afterwards be kept quite free from weeds; they must, as they advance in height, have some soil drawn up around the lower part of their stems; and, when they attain their full size, they must be closely tied up with hay-bands, and afterwards earthed up almost to their tops. But in the process of earthing up, care must be used not to allow any of the soil to fall amongst their leaves, and the soil heaped around each plant must be smoothed over the surface to cause the rain to run off; for either the falling of a little soil among the leaves, or the penetrating of rain through the earthing up, might occasion the plants to rot. The thorough blanching of the leaf-stalks, to the height of from one foot to three feet, will be effected in the course of five or six weeks from the time of earthing up, so that when a succession is wanted for the table, only a few plants should be earthed up at one time, and successive sets or groups or even individuals of them may be earthed up at intervals of seven or ten days. If severe frost occur in the early part of winter, a covering of straw or haulm must be placed on the tops of such plants

as remain; and whenever mild weather returns, this covering must be removed. Other sowings than the March one may be made in the early part of April, and thence till the middle of June; and the plants from these must be treated in the same manner as those from the March sowing.

CAREX. A very numerous, prominent, and extensively diffused genus of grass-like plants, of the cyperaceæ or sedge tribe. Eight species grow wild in England, ten species grow wild in Scotland, between forty and fifty species grow wild in both England and Scotland; about sixty species have been introduced from other countries, principally the central and northern regions of continental Europe; and nearly three hundred species have been scientifically described. A few grow on sandy eminences, heaths, and sea-shores; but most grow in marshes, fens, bogs, watery meadows, flooded banks of streams, sides of ditches, humid woods, and other moist grounds and watery situations. Some intrude, to a considerable degree, among our cultivated herbage-plants, and are then annoying and wasteful weeds; some frequently mix with the natural grasses, and form a coarse portion of the useful sward of meadows; some cover extensive tracts of low, fenny, alluvial country, and are available partly as a very coarse herbage, and partly for various economical purposes; and many are mere wasteful occupants of waste lands, either proclaiming the hopeless uselessness of the situation in which they grow, or indicating the most clamant necessity for subjecting it to thorough drainage and general georgical improvement. They are, in the aggregate, vastly inferior to the grasses in the possession of nutritive properties, and are almost distinguished for the absence of the farinaceous and saccharine principles in which many of the grasses abound; and hence, in even their most favourable specimens, they are eaten by cattle only when the grasses or other nutritious herbage cannot be obtained. Yet many cottiers and some poor farmers have recourse to them as fodder, and use them for litter, thatch, and fuel. The Laplanders manufacture from some of them a flaxy fibre for protecting their feet and hands from the rigours of winter; the Italians use some for stuffing the crevices of casks, making bottoms of chairs, and covering flasks of Florence oil; and the hop-cultivators of Kent use the leaves of some of the larger kinds for fastening the vines of hops to the poles.

The roots of probably all the species are perennial; those of most are creeping; and those of a few are tufted and fibrous. The stems of all are simple; and those of most are free from knots or joints, and have thin, acute, and finely serrated angles. Their leaves are linear, flat, pointed, roughish in the surface, sharp along the edges, tubular and sheathing at the base, and membranaceous, often auricled, at the summit; and the upper ones assume the character of bracts. Almost all seed freely, and in consequence are

facilely propagated; yet the upper spikes of all consist only of male flowers, and never produce seeds; and their invariable want of fruitfulness is alluded to in the name of the genus, which is derived from the Latin word *carere*, 'to want.' Two of the British species, having a height of from six to ten inches, are diœcious, and have solitary spikes; thirteen, having a height of from six inches to a yard, have their spikelets spiked, and are many-flowered; two have panicle spikelets; one has a racemose spikelet; and the others possess some other equally distinctive characters, which render them easily recognisable from one another, and occasion the whole to be classifiable into eleven or twelve groups. "*C. remota*," says Loudon, in his *Encyclopædia of Plants*, "is a very elegant plant. *C. paniculata* grows in bogs in immense tufts, making a firm support for the heaviest bodies. *C. Fraseri* is the handsomest species of the genus, resembling at a short distance, when in flower, one of the liliaceæ. *C. riparia* has leaves half an inch wide, and from one to three feet long. *C. arenaria* increases rapidly in loose sand, and is sometimes planted with a view of fixing soils of this description, along with *elymus* and *arundo*."

CAREYA. A small genus of very beautiful, evergreen, East Indian plants, of the myrtle tribe. It is named after its discoverer, Dr. William Carey of Serampore, the editor of *Roxburgh's Flora Indica*. The herbaceous species has a height of only about six or eight inches; it carries a splendid flower, with long red stamens, in July and August; and it was introduced to Britain in 1808. The spherical and the tree species are arborescent, and have a height of respectively three feet and ten feet, and were brought to Britain in 1823.

CARICA. A genus of ornamental, fructiferous, evergreen, tropical trees, of the Linnæan class diœcia, and order decandria. Its proper natural place is probably in close juxtaposition to the nettle tribe, but is a subject of much dispute among botanists; and the genus was placed by Linnæus among the tricoccæ, by Richard among the passifloræ, and by Jussieu, but not by De Candolle, among the cucurbitaceæ. The name carica is an erroneous allusion to Caria, as the supposed native country of the best known species; and it was proposed by Jussieu to be changed to papaya.—The common or papaw-tree species, *Carica papaya*, is a native of India and of South America, and was introduced to Britain, from the former of these countries, toward the close of the seventeenth century. Its stem is upright, unbranched, rapid in growth, and from fourteen to twenty feet in height; its foliage is large, and confined to the top of the tree, and gives the plant an appearance somewhat like that of a palm; its flowers have a yellowish-white or greenish colour,—and when the corolla falls, the germs, in growing to maturity, becomes pendent; its fruit is a large oblong berry or papo, nearly

allied to a fig in character, and similar to a quince in shape and size; and the tree, while advancing in height, casts its lower leaves from beneath the flowers, and suspends its fruit upon the leafless part of the stem, like the flowers of cercis, the spines of gleditchia, or the bread-fruit. The male flowers are sometimes on different trees from the female, giving just occasion for ranking the plant as dioecious; yet both male and female flowers are sometimes found on one tree, and sometimes flowers are found to be hermaphrodite. Every part of the plant yields an acrid and somewhat milky juice. The flowers appear at almost all seasons of the year, but are most abundant in July; and the fruit is usually ripened in autumn and in early winter. The fruit is eaten with pepper and sugar by the inhabitants of some of its native countries, but has not an agreeable flavour; more commonly it is gathered in a half-grown state, well-pickled, and used as a tolerably good substitute for mangoes; and sometimes it is boiled and baked in the manner of turnips and apples, and esteemed not a bad esculent. Some fruit has been produced in the stove-houses of British gardens; but it has not, by any means, proved palatable. The juice of the pulp is used as a vermifuge, as a cosmetic, and as a substitute for soap; and, when diluted with water, it has the remarkable property, by immersion in it during only eight or ten minutes, of rendering meat tender. It appears to effect a separation of the muscular fibres of meat; and it has been found, by chemical analysis, to contain fibrin or animal matter. The very vapour of the tree seems to produce the same effect as the juice of the pulp; for recent butchers' meat and newly killed fowls are suspended upon it to acquire tenderness. The flesh of hogs which have fed upon the fruit will not keep by salting. The seeds contained in the centre of the fruit are dark-coloured, and taste like water-cress.—Five other species, all about the same height as the papaw-tree, are known to botanists, and have been introduced to Britain,—two from the Caraccas, and three from respectively Lima, Guiana, and Guinea.—*Carica* is also the specific name of the common fig-tree, *Ficus carica*. See the article FIG-TREE.

CARIES. A mortified or dead condition of the bones of animals. It is produced by inflammatory and suppuratory action in the interior tissues of a bone; or by the loss of the medium by which the bone is covered and partially supported. A mortified or dead condition of the wood or bark of trees is also called sometimes caries, but more frequently canker. See the article CANKER.

CARISSA. A genus of evergreen, tropical trees and shrubs, of the dog's-bane tribe. The Carandas species, *Carissa carandas*, is a native of India, and was introduced to Britain in 1790. It usually has a height of about fifteen feet; its flowers are white, and resemble those of jasmine,

and appear in July; and its fruit is black, and about the size of a large olive, and has a very pleasant taste, similar to that of a damson, and is much esteemed by the inhabitants of India for making both pickle and jelly.—The spiny species, *Carissa spinarum*, grows wild in the woods of India, and was introduced to Britain in 1809. Its stem usually attains a height of about twenty feet, and is used as timber; its leaves have a leathery texture; its flowers are white, and appear from August till December; and its fruit is small, dark-coloured, pleasant-tasted, and much esteemed by the Hindoos.—Three ornamental species, the ovate-leaved, the lanceolate-leaved, and the bitter-wooded, were, about twenty-five years ago, introduced to Britain,—the last from Mauritius, and the other two from Australia.

CARLINE THISTLE,—botanically *Carlina*. A genus of herbaceous plants, principally hardy, of the thistle division of the composite order. The common species, *C. vulgaris*, is a biennial weed of dry pastures, and arid barren soils, in Britain, and in most other countries of Europe. It has a height of about twenty inches, and carries yellowish-purple flowers from June till September. Its flowers expand in dry weather, and close in moist weather.—The dwarf or stemless species, *C. acaulis*, is a native of Italy, and was introduced thence to Britain about the middle of the 17th century. Its root is black, woody, perennial, and about an inch in thickness; its entire height is about nine inches; and its flowers are white, and appear in June. The root of the full grown plant contains acrid resinous matter, and is said to act as an alexipharmic; but the upper part of the young root, and the tender receptacle of the flower, may be used as esculents.—Nine other species—two of these annual, and the others perennial—have been introduced to Britain from the south of Europe; seven or eight additional species are known to botanists; and some species, formerly classed as carline thistles, are now assigned to other genera.

CARNATION,—botanically *Dianthus Caryophyllus*. One of the most fragrant, beautiful, and popular of florists' flowers, and the type of the natural botanical order Caryophyllæ. This order comprises twenty-six genera, and has, within the gardens of Britain, about 550 species. Its plants are natives of the mountains and pastures, chiefly of Europe and northern Asia, and partially of almost all other regions of the world. About five hundred of the species in Britain are hardy herbaceous plants; one is a hardy ligneous plant; and the others are herbs and undershrubs of the hothouse and the greenhouse. Many are mere weeds; a few are medicinal; one or two are esculent; and a large number, including all those of the dianthus genus, are eminently handsome, and, in some instances, splendid. The genera most nearly allied to the carnation, or to the genus to which it belongs, are silene, lychnis, gypsophila, saponaria, drypis, cucubalus, and vele

zia; and the other genera of the order are alsine, cerastium, elatine, stellaria, arenaria, ortegia, mollugo, buffonia, holosteum, spargulastrum, cherleria, sagina, drymaria, spargula, larebra, pharnaceum, moehringia, and bergia.

But though *Dianthus caryophyllus* is the carnation of botanists, only the variety of it botanically designated *Dianthus caryophyllus flore-pleno* is the carnation of florists. The normal or single-flowering plants of the species, though comprising some permanent subvarieties, and many fugitive or seminal subvarieties, and though possessing all the fragrance and much of the beauty of the species, are never permitted a place in a garden collection of carnations, and seldom dignified, in any part of the parterre, with a higher name than that of clove-pinks. Two other thoroughly established varieties of the species, *D. c. fruticosus* and *D. c. imbricatus*, also possess great beauty, and yet are popularly kept separate from the fellowship of the carnations, and designated respectively the shrubby carnation and the imbricated white-ear. Yet while only the variety *D. c. flore-pleno* is permitted to wear the garden honours of the carnation, it comprises a sufficiency of subvarieties to gratify the most capacious taste, and a sportive power of self-variegation sufficiently active and multitudinous to keep even a morbid love of novelty in constant play.

The carnation, in its normal or botanical sense, may be gathered wild on the south side of the Swiss Alps, and may occasionally, though very rarely, be seen wild about walls in England. But the carnation, in the floricultural or popular sense, is wholly the result of cultivation, and can be propagated or even maintained only by artificial aid. It is not noticed by Pliny or any of the Roman poets, and probably was unknown to floriculture at the period of the Roman empire; yet it has, for several centuries, been cultivated in most parts of Europe, and held in high esteem, for both its fragrance and its beauty, throughout a large portion of the civilized world. The number of named and much-esteemed subvarieties of it, at the beginning of the eighteenth century, was nearly four hundred; the number of new, good, named subvarieties has, for a century past, received an annual increase in almost every considerable district of European gardens; and thousands of seedlings, somewhat new in character, but wanting sufficient interest to command more than the most momentary attention, are annually produced by florists and amateurs. As excellent and very beautiful subvarieties have multiplied, taste has become increasingly fastidious; and now it not only condemns all flowers of defective shapes, feeble power of development, or bad mixtures of colours, but rejects from the very name of carnations all flowers of *Dianthus caryophyllus flore-pleno* which have the pervading red colour of "the clove-pink," all which have yellow for their ground colour, and all others, be

they what they may, which have not a ground colour of pure, unspotted, untinged white.

All carnations, understood within these restrictions, are classified into bizzarres, flakes, and picotees; and those of each of these classes are distributed into two or more subdivisions. Bizzarres are striped with two colours on their white ground, and have these colours in irregular variegations; flakes are striped with one colour on their white ground, and have their stripes large, and extending quite across the petals; and the picotees are pounced and spotted in a great diversity of manner on their white ground, and have, in general, a smaller size and a harder habit than the other classes. The bizzarres, in many instances, have a greater proportion of one of their striping colours than of the other; yet those are esteemed the best which exhibit the two colours in nearly equal proportions, and have the stripes running parallel to one another, and distributed equally over the flower. Some flakes have too much of striping colour, and others have too little; those being the best which exhibit the striping colour and the ground colour in well-balanced proportion. The picotees were formerly regarded as having, for a distinguishing character, fringed or notched edges round their petals; but all such picotees as possess this character are now regarded as deformed; and those are esteemed the best which have a smooth edge, or what is technically termed a rose leaf, with the colours bright, clear, and very decidedly marked. Scarlet bizzarres are striped, upon their white ground, with scarlet and dark maroon; and the several kinds of them differ from one another in the intensity of these colours. Crimson bizzarres are striped, upon their white ground, with either pink and purple, or rose-colour and purple; and those which have shades of pink have a livelier and lighter appearance than those which have shades of rose-colour. Flakes are distributed into three subdivisions,—one with scarlet stripes, one with rose or pink stripes, and one with various hues of purple; but each subdivision has great diversity in the depth and shading of its characteristic colour. Picotees comprise very numerous and widely different varieties; and are distributed into four subdivisions, with respectively scarlet, crimson, rose, and purple colours. Each of the subdivisions of picotees, also, is distributed into two groups,—the one heavy-edged, with the colour thickly laid on round the margin of the petals,—and the other feathered, or light-edged, with the colour touching the petals in an unbroken delicate line.

The proper cultivation of prime carnations has been a topic of very varied and exceedingly copious discussion; yet may be most satisfactorily disposed of in a single paragraph. The soil may be either two-thirds of rotted turf and one-third cow-dung, or equal parts of loam, leaf-mould, and cow-dung; and if it should seem too strong

and adhesive, it may be tempered with a little silver sand. In April, after the soil has been passed through a sieve, and freed from wire-worms, and filled into pots, young plants from layers or pipings of last year, should be planted, one in each pot. For a time, they require no other care than to be properly watered; when they begin to "spindle," each must be allowed to send up only one stem, and must be tied up to a neat stake; and as soon as they incipiently bud, each must be deprived of all its buds except three, or, if it be a weak bloomer, it must be deprived of all except two. When the buds become fully swollen, but before they burst, a ligature should be tied round each pod, half way down, and as soon as the bursting commences, so that the ends of the calyx can be separately laid hold of, the divisions of the calyx should be torn down as far as to the ligature. When the best of the bloom is over, the longest shoots of the plant, technically called its "grass," should be layered; and in September, the layers may be cut off and potted in the loam of rotted turf, without any manure. Any of the "grass" which is too short for layering may be piped in the same manner as pinks. Throughout the winter, the plants must be kept dry, well protected from rains, frost, and high winds, and abundantly ventilated during every hour of mild or even moderate dry weather. Second-rate plants, and even the hardier sorts of first-rate ones, may be grown in good, well-manured loam, in the open ground; and the layers of them may remain with them unprotected, or nearly so, throughout the winter, and may be detached and transplanted to situations of their own in the open ground in spring. Some kinds of excellent plants have so strong and healthy a habit of regularly or unburstingly expanding their blossoms, that, except for the purposes of a special show, they require no tying of their pods or splitting down of their calyxes.

CARNIVORA. The surface of the earth, clothed with verdure, is the inexhaustible source whence man and animals derive in common their subsistence. Every animated being lives ultimately upon vegetables, and vegetables are maintained by the debris or remains of everything which has lived and vegetated. A perpetual round of existence is thus maintained. Without death there could be no life, and it is only by annihilating other beings that animals are able to support themselves, and to continue their species: they must either feed on vegetables or upon other animals. Yet Nature, like an indulgent mother, has fixed limits to this apparently indiscriminate destruction. The carnivorous and voracious individuals are reduced to a small number, while she has largely multiplied both the species and individuals which are herbivorous. Man too has greatly assisted in exterminating, or confining within narrow limits, the predaceous species, and in establishing the more peaceful tribes. Among the marine genera, although some are herbivor-

ous, yet the greater number are nearly equally voracious. These devour their own and different species without ever appearing to exterminate each other, because their fecundity is as great as the destruction; and nearly all this mutual consumption acts as a new incentive to reproduction.

Man stands foremost among the carnivorous tribes. Being the predominant species, he exercises over the other mammalia the privileges of a master. He has chosen those which please his taste, and forms them into humble dependents. By causing them to multiply more rapidly than unassisted Nature would have done, they have given rise to numerous flocks; and from the care bestowed in their production, he acquires a natural right of immolating them to satisfy his wants. This power, however, extends much farther than his necessities would require; for, independent of those species which he has subdued and can dispose according to his pleasure, he carries on a war of extermination against the wild beasts, the birds, and the fishes. He does not even confine himself to the climate which he inhabits, but seeks for new delicacies in the remoter parts of the globe. Nature seems scarcely adequate to supply this continual demand for variety, and man alone may be said to consume more animal food than all the other mammalia taken together. Next to man, the carnivorous beasts possess the most destructive habits, and are at once the enemies of their fellow-animals, and the rivals of man. Having the same appetites and the same fondness for animal food, they are under the necessity of disputing with him the possession of their prey; and in the first ages of human society these formed one of the most formidable checks to civilization. Even at the present time, in civilized Europe, it is by the utmost vigilance alone that he can preserve his flocks and poultry from the ravages of the wolf, the fox, the ferret, and the weasel. All animals, whether of the same or of different species, are naturally in a state of warfare. It is chiefly in the tribes more particularly styled carnivorous, that this war proceeds to open hostilities; yet there is a silent and a secret opposition of interest, even among the most peaceful tribes. As their numbers continually increase, food becomes scarce, disease thins their numbers, and the remainder fall a ready prey to the stronger and fiercer animals. Like plants, they destroy each other as effectually by the mere occupancy of space as they could have done by the fiercest conflicts. The rising generation soon repairs the loss occasioned by the latter, but nothing can extend the numbers of a species beyond the limits marked by Nature in the quantity of its food. This universal war of species is an established law of Nature, and, however startling it may appear at first sight, is advantageous on the whole. Violent deaths are as necessary to the proper regulation of Nature as natural deaths. The latter preserve the per-

petual bloom of youth over the face of the earth ; the former assist in maintaining the correct balance among the numbers of different species, and in restraining their exuberance within the proper limits.

In these wars of the animals, Nature has provided that each creature should meet its death in the easiest possible manner. There is a certain spot in the spinal marrow where the two ascending main nerves that form the great brain cross one another, and if this spot be injured, death is the immediate consequence. This fact is well known to huntsmen and butchers. The latter plunges his knife into the neck of the ox at that exact spot, the animal immediately drops, and ceases to live after a few convulsions. On the same principle the huntsman cuts through the neck of his game. The carnivorous animals always seize their prey by the neck, and bite through this part. In the same manner the hound kills the hare, and the bird of prey its quarry. The pole-cat also destroys its prey at a single spring. Dr. Gall locked up a pole-cat for some time, during which he fed it on bones till its teeth were blunted. While in this state, it was unable to kill the rabbits placed in its kennel with the same despatch as formerly ; but when they had again grown sharp, Gall observed that, on the very first leap it made on the rabbit, it cut the little animal's neck on that very spot with a sharp fang, and instantaneous death ensued. He observed the same thing at a hawking party. As soon as the hawk had reached the hare, it would immediately cut through that part of her neck with its bill.

It is the organization of the carnivora—the possession of teeth, of claws, of short and narrow intestines—that imposes the office of Nature's executioners upon these animals by an imperative necessity. The sharp teeth of the leopard or panther might attempt in vain to grind plants : and even when we compel these animals to swallow bread and other purely vegetable substances, the gastric juice of their stomach is unable to dissolve them. On the contrary, the lamb and the light gazelle would refuse animal food with disgust. Their teeth are not formed for tearing, and their entire economy is adapted to a vegetable diet. It is thus that we find, in the organization of the animal, the reasons for all its actions. This exquisite relation of all the parts of an animal to each other, enables the Naturalist to describe the whole creature on seeing only a part. Thus, from knowing the size of a tooth, we can judge of the height of the animal which bore it ; by the shape of the tooth we can tell whether it be carnivorous or herbivorous. Thence follow the general structure of the body, not only of the stomach and viscera, but also the form of their paws, of claws with the one, or of hoofs with the other, the liveliness of their passions, as well as the habits which attend this kind of life and constitution.

Besides the claws and teeth, which form the offensive arms of the carnivora, they are endowed with superior strength, agility, cruelty, and treachery. The source of these qualities must be sought in the nature of their food—in the superior organization of flesh and blood. The herbivorous tribes want offensive arms in general, yet they are seldom of a timid or peaceful disposition. They love to unite together in social bands, to pasture on the plains or by the mountain side, or else to hoard the common fruits of their industry. The carnivorous tribes, like tyrants, are unfitted for society by their ferocious and domineering tempers ; they dread the rivalry of their own species, and the natural attachment of the sexes is with them but a momentary passion. They can endure hunger much longer than the herbivorous tribes, whose food is always spread out before them ; and this power of fasting is necessary to animals obliged by their structure to overpower their prey by violence, to run them down by perseverance, or to surprise them by stratagem. They can fast for several weeks, but as their necessities increase they become bolder and more ferocious. The wolf, with an appetite sharpened by famine, becomes an intrepid and formidable enemy. He then invades the villages, breaks into the stables during the day-time, and even ventures to contend with man. But when he has found an abundance of nourishment, he gorges himself for several days ; and, with an admirable sagacity, conceals the remainder under ground as a provision for future want. This continual use of animal food, and the high state of organization at which all the solid and fluid parts of their bodies have arrived, renders their flesh at once unpalatable and unwholesome. Their excretions are all fetid, and the slightest check to the vital activity brings on a rapid decay. On the contrary, the vegetable nutriment of the herbivorous tribes imparts to their flesh a high degree of delicacy. Their milk is sweet, agreeable, and nutritious. Thus the herbivorous tribes yield an abundance of nourishment to man, while he rejects with disgust the flesh of those which are carnivorous.

The natural antipathy of some of the carnivorous animals for each other, proceeds from their rivalry in the chase. It is thus that the lion, tiger, panther, or bear, permits no poachers upon his hunting grounds. These despots of the animal kingdom allow few intruders to share their authority, and clear the forest of all those petty tyrants which prey only upon small game ; and which, like the inferior *noblesse* of the middle ages, oppressed the lower ranks, and diminished the population.

It is in barren and unfrequented districts that the carnivorous animals are most fierce and sanguinary, because their prey is scarce, and the possession of it is continually disputed by a host of famished rivals. From these continued scenes of violence their character acquires an unusual

ferocity. The bear of the Alps is a formidable and dangerous animal to the traveller. But the beasts that frequent the plains or fertile valleys find their food more easily, and when found it is less disputed. Their character being thus softened down by the comforts of life, loses that high degree of courage and asperity which distinguishes the mountain races. The carnivorous animals associate in troops only for the convenience of a combined attack; on the other hand, the herds of herbivorous animals seem intended only for their mutual defence. Placing the young ones in the centre, and the females in the rear, the males advance to the front, united in a phalanx, and presenting their horns to the enemy, repel his attack with vigour, and generally with success.

CAROB-TREE, — botanically *Ceratonia*. A small evergreen tree, of the cassia division of the leguminous order. It constitutes a genus of itself, and takes for its specific name *siliqua*. It abounds in Spain, Italy, and the Levant, and was introduced to Britain in the latter part of the sixteenth century. Its stem usually grows to the height of about fifteen feet; its leaves are differently shaped from those of most other evergreens, and render it an agreeable variety among orange-trees, myrtles, and other greenhouse arboreous plants; its flowers have a reddish-yellow colour, and appear in September and October, but are seldom produced in Britain; and its pods are long, flat, horn-shaped, and brown-coloured, and contain a thick, mealy, sweetish-tasted fecula. This plant appears to be the locust-tree of scripture, and is generally known in Spain under the name of St. John's bread. The shells of the pods are supposed to be the husks alluded to in our Saviour's beautiful parable of the prodigal son; the seeds are imported from Arabia into Spain, under the name of algaroba beans; and the pods of native growth are eaten in times of scarcity by the Spanish peasantry, and were the principal food of the horses of the British cavalry during the peninsular war.

CAROLINEA. A genus of magnificently-flowering, small, evergreen, tropical trees, of the silk-cotton-tree tribe. The showy species, *C. insignis*, was introduced from the West Indies in 1796; and is one of the most gorgeous stove-plants in Britain. It attains a height of from twenty to thirty feet; its leaves, except for being evergreen, are very similar to those of the horse chestnut-tree; its flowers have a rich crimson colour, and measure about a foot in diameter; and the stamens of its flowers are as numerous as those of a cactus, and form a magnificent spreading feather. Three other species, the white, the less, and the princely, have been introduced,—the last from the West Indies, and the other two from tropical South America; all grow to about the same height as the showy species; and the white carries white flowers, and the other two carry flowers with mixtures of red and yellow and green.

CAROTA. See **CARROT**.

CAROTID ARTERY. One of the principal arteries of the neck of man and of other red-blooded animals. The name carotid is formed from a Greek word which signifies 'to cause to sleep;' and it alludes to the supposed power of a ligature round this artery to produce coma or sleepy stupor.

CARP. A genus of soft-finned abdominal fish, which Cuvier makes the fourth family of the order. This is a very natural genus, containing very numerous species. It is easily distinguishable by the small mouth, toothless jaws, and gills of three flat rays. The tongue and palate are smooth, but the gullet is admirably constructed for mastication, having large teeth attached to the inferior pharyngeal bones, which press the food between themselves and a gelatinous knob, connected with a bony plate that is united with the first vertebra, commonly called the carp's tongue. They have but one dorsal fin, and the body is covered with scales, generally of large size. They frequent fresh and quiet waters, feeding on herbs, grains, and even mud, being, perhaps, the least carnivorous of the finny race. Some of the species have a beard of small fleshy threads at the angles of the upper jaw.

The most noted of the species are the common carp, *C. Carpio*, which, in many parts of the world, are bred in ponds, for the use of the table, and the goldfish, *C. auratus*, believed to be originally from China, very commonly bred in ponds and vases as an ornament, on account of its beautiful colours. In his memoir on American Ichthyology, Dr. Mitchill enumerates four species of carp, under the names of *C. teres*, fresh-water sucker; *C. oblongus*, chub of New York; *C. chrysoleucas*, New York shiner; and *C. atronans*, brook minnow.

The common carp of Europe is esteemed very highly for stocking ponds, being of quick growth, spawning thrice a-year. As the females do not commence breeding until eight or nine years old, it is necessary to keep up a supply of carp of that age by avoiding to destroy the females. The proportion of males to be preserved is four for every twelve females. Under common circumstances, the carp grows two or three inches in length in a year; but, where the ponds are exceedingly well supplied with food, they have been known to grow from five to eighteen inches in the same time. They thrive best in ponds having clayey or marly sides, and well provided with aquatic vegetables. In order to furnish them with fresh vegetable food, it is usual to rake the sides of the pond, left dry by evaporation, with an iron rake, and then to sow grass-seed, so that, when the pond is again filled up by the rains, there may be a growth of tender herbage for the fish. Grains of various sorts, and garbage, are frequently thrown into the pond, with a view to aid in fattening carp. A pond of one acre in extent is said to be sufficient to feed 300 carp of

two or three years, or 400 of one year old. Carp, in their native condition, frequent the deepest places of ponds or rivers, where there is the least current. It is a fish which requires much patience and address in the angler. They seldom bite in cool weather, but, during hot seasons, bite very freely. The bait commonly used in angling for carp is worms, and sometimes grasshoppers. Various sweet pastes are also used, formed of honey or sugar, mingled with flour and small quantities of veal, pounded together in a mortar, till sufficiently tough to adhere to a hook without being easily washed off. A little white wool, mixed with the other ingredients, is of great assistance in giving the mass the requisite tenacity. To increase the pleasure and profit of carp fishing, it is well, for a few days previous, to have some brewer's grains or other food thrown into the water, by which the fish will be induced to collect at any particular place in greater numbers.

CARPET-WAY. A grassy path, or unploughed stripe of lea-land, through the middle of a ploughed or cropped field.

CARPINUS. See **HORNBEAM**.

CARRIAGE. A conduit, trench, or duct, in the irrigation of meadows, for conveying the water of one main over the stream of another main flowing in a transverse or rectangular direction. It is sometimes built of brick, and is then conducted over the stream below it by an arch; but it is more frequently constructed of timber, and it then consists of bottom and two sides, with the same capacity as the main to which it belongs. Its length is determined by the breadth of the main which it crosses.

CARRIAGE. Any kind of draught-vehicle, for the conveyance of goods or persons from one place to another. The clumsiest cart for the conveyance of coarse and heavy articles upon a farm, and the most luxurious cabriolet for the pleasure-drives of gentry, are alike carriages; and both these and all intermediate sorts of cars, waggons, and chaises, are characterized by the possession of wheels and axle,—while most, including all the better kinds, are characterized also by the possession of springs. "Taking wheels completely in the abstract," says Mr. D. Giddy to the committee on the Highways of the Kingdom, "they must be considered as answering two different purposes. First, they transfer the friction which would take place between a sliding body and the rough uneven surface over which it slides, to the smooth, oiled peripheries of the axis and box; assisted by a leverage in the proportion of the diameter of the wheel to the axis. Secondly, they procure mechanical advantage for overcoming obstacles, by introducing time proportioned to the square roots of their diameters, when the obstacles are small, as compared with the wheels; and they pass over transverse ruts or hollows, small in the same comparison, with an absolute advantage proportioned to their dia-

eters, and a mechanical one proportionate to the square roots of these diameters. Consequently, wheels, thus considered, cannot be too large; in practice, however, they are limited by weight, by expense, and by experience. With reference to the preservation of roads, wheels should be made wide, and so constructed that the whole breadth may bear at once; and every portion in contact with the ground, should roll on without any sliding. It is evident, from the well known properties of the cycloid, that the above conditions cannot all unite, unless the roads are perfectly hard, smooth, and flat; and the felloes of the wheels, with their tire, are accurate proportions of a cylinder. These forms, therefore, of roads and wheels would seem to be asymptotes, towards which they should always approximate, but which, in practice, they are never likely to reach. Roads must have some degree of curvature to throw off water, and the peripheries of wheels should, in their transverse section, be as nearly as possible tangents to this curve; but since no exact form can be assigned to roads, and they are found to differ almost from mile to mile, it is presumed that a small transverse convexity given to the peripheries of wheels, otherwise cylindrical, will sufficiently adapt them to all roads, and that the pressure of such wheels, greatest in the middle, and gradually diminishing towards the sides, will be less likely to disarrange ordinary materials, than a pressure suddenly discontinued at the edges of wheels perfectly flat.

"The spokes of a wheel should be so arranged as to present themselves in a straight line against the greatest force they are in common cases likely to sustain. These must evidently be exerted in a direction pointed towards the carriage, from lateral percussions, and from the descent of either wheel below the level of the other; consequently, a certain degree of what is termed dishing must be advantageous, by adding strength; whilst this form is esteemed useful for protecting the nave, and for obviating the ill effects of expansions and contractions. The line of traction is theoretically best disposed, when it lies exactly parallel to the direction of motion; and its power is diminished at any inclination of that line, in the proportion of the radius of the wheel to the cosine at the angle. When obstacles frequently occur, it had better, perhaps, receive a small inclination upward, for the purpose of acting with most advantage when these are to be overcome. But it is probable that different animals exert their strength most advantageously in different directions; and, therefore, practice alone can determine what precise inclination of the line is best adapted to horses, and what to oxen. These considerations are, however, only applicable to cattle drawing immediately at the carriage; and the convenience of their draught, as connected with the insertion of the line of traction, which continued ought to pass through the

axis, introduces another limit to the size of the wheels.

"Springs were, in all likelihood, first applied to carriages with no other view than for the accommodation of travellers: they have since been found to answer several important ends. They convert all percussions into mere increase of pressure, thus preserving both the carriage and the materials of the roads from the effect of blows; and small obstacles are surmounted when springs allow the frame and wheels freely to ascend, without sensibly moving the body of the carriage from its place. If the whole weight is supposed to be concentrated on springs very long, extremely flexible, and with the frame and wheels wholly devoid of inertia, this paradoxical conclusion will most certainly follow,—that such a carriage may be drawn over the roughest road without any agitation, and by the smallest increase of force. It seems probable that springs, under some modification of form and material, may be applicable with advantage to the heaviest waggon."—See the articles CART, DRAUGHT, WAGON, and WHEEL-CARRIAGE.

CARPENTERS' WORK. The following observations on the measurement and valuation of carpenters' work may be found useful to farmers and agriculturists in general. Carpenters' work is done under three distinct contracts,—called labour and all materials; labour and nails; and labour only. The first is when the workman provides the timber for his employer, and does all the necessary work upon it, at the same time providing the necessary materials, such as glue, nails, screws, &c., for putting the work together. Under this contract, locks, bolts, hinges, and other articles of ironmongery are never included, but constitute a separate charge, according to their number and value. The second form of contract, labour and nails, implies that the employer provides all timber and other materials, except nails, and that the workman puts the work together and fixes it, finding all such nails, spikes, or trenails as are necessary, but nothing else. The third is where everything is provided by the employer, and the workman merely furnishes labour. The first mode of working is generally resorted to for all small jobs, in which it would not be worth the employer's while to purchase his own materials, especially as he might procure too much or too little, and every carpenter usually keeps a small stock of such materials on hand.—The second mode, of finding labour and nails, is the one constantly resorted to in England for all building contracts. It has come into use from the very careless manner in which nails are treated by workmen, unless they have to pay for them. When this is not the case, as many nails are frequently spilt among the shavings and swept away as would complete the job, while in labour and nail work, a spare nail is seldom seen upon the ground. Nails are likewise an article of ready sale; and are therefore frequently pur-

loined by labourers, unless they are taken good care of.

All carpenters' work, whether done by one or other of the above contracts, is measured and charged for by superficial measure, taken in what are called *squares*, that is, 100 superficial feet, or else by the single foot. Thus all naked floors, roofs, or partitions are computed in squares and $\frac{1}{100}$ parts of a square, being superficial feet, and they are said to be worth a certain price per square, according to the distance apart of the joists, rafters, or studs, and whether they are morticed into, or simply notched down upon bridging joists, girders, &c. If a carpenter covers a naked partition with weather boarding, or a naked floor with boards or battens, still the measure and value is determined by the number of squares. A square of work is therefore worth a certain price for labour only; but if nails are also found, then the value of as many nails as ought to be used in a square of such work must be added. When the work is small and neat, it is taken in superficial feet instead of squares; while skirtings and many other things belonging more to joinery than carpentry, are measured and valued by lineal feet. It will thus be seen that the measurement of carpenters' work for labour only, or labour and nails, is very simple; but when all materials have been found, the above process must be gone through, and the price of the materials must be added, which increases the complication of the process, because not only the general surface, but each individual piece of timber that occurs in the work has to be measured and set down in three dimensions; viz., length, breadth, and thickness, to determine its cubic measure. The kind of timber must also be specified in the measuring book, provided the timbers used are of various kinds, with different prices per foot cube. The same ruling is used for the carpenters' measuring book as for the bricklayers', and the columns are appropriated to the same purposes, viz., the first on left for coefficients, when pieces of the same size are often repeated, as in joists and rafters. The second column for the dimensions as taken; but these are always set down in three, instead of two lines or quantities, the breadth occupying the top line, the width the second, and the length the third; because to cube timber the breadth and width are multiplied into each other, and their product into the length. The third column is therefore left blank for receiving the cubic quantities, when afterwards computed at home, and this quantity must of course be multiplied by the coefficient, when one exists. The fourth column is filled up with the kind and quality of timber, as oak, pine, &c., and the form in which it exists in the work, as joists, lintels, rafters, &c. This dimension book not only requires to be cast up, but to be afterwards abstracted, in order that all the same quality of timber (or work if required) may be got together, when the whole quantities can be

stated in single sums with the appropriate value set against each. Piles used in foundations are valued at per piece, or by cubic measure; and, if their driving is contracted for, it is estimated by the foot run, according to their length, size, and the nature of the ground. Centring for arches is sometimes made and fixed by the square; but, in general, the engineer considers this as work of too nice a nature to be trusted to contractors, and he prefers executing it as day-work by the best hands. Wall-plates, lintels, and bond-timber are measured by the cubic foot, under the denomination of fir or oak in bond. All timber used in foundations, naked floors, ceilings, &c., should be measured in presence of the parties concerned, as soon as fixed; because disputes frequently arise about the size and quality of timber after it is buried in the ground, or concealed by boarding or plastering, and these can only be arranged by undoing part of the finished work, occasioning delay, expense, and inconvenience. In measuring timber that is plained or wrought, the size of the piece before worked upon must be set down; also in pieces on which tenons or mitres have been cut, the length must be taken to the extreme end of the tenon or mitre, as these were as large as the rest of the stick before cut; and when the nett quantity of timber found in any regular work is measured and set down, a twentieth part of the gross quantity is usually added, to allow for inevitable waste, on account of the ends of all planks, boards and sticks being split, shakey, and unfit for use; on which account they are cut off, which is also the case with the sides of boards, and many other pieces. This allowance would not, however, compensate for circular work, such as the ribs or arch-moulds of centres, and the curbs for sinking wells, for these, though curved, are cut out of straight wood, and as the curved pieces that come off are cross-grained and useless, so the actual size of the piece of timber, before converted, is always charged for, instead of the nett quantity that occurs in the curved piece that is used. Journeymen carpenters and joiners are always expected to provide and furnish their own tools, the use of which is included in the price of their wages; but the bench they work at, and a grindstone for sharpening such tools, are provided by the employer, together with any tools that may be necessary for particular and uncommon operations.

The measurement of joiners' work, although in some respects more simple, inasmuch as it scarcely ever involves anything beyond lineal and superficial measure, becomes apparently intricate from the great variety of technical terms made use of in joinery to express the forms of things, or the articles made. Generally speaking, however, all doors, sashes, shutters, floors, stair steps, &c., with their architraves, surbases, jaumbas, soffits, and other articles made by the joiner, are measured by the surface they present superficially, and are charged at so much the square foot; the

price being regulated by their intricacy and finish, which will occupy more or less time. If work is enriched with many mouldings, and a superficial price to include the whole cannot be agreed upon, it is a common practice to obtain a price, by measuring the ground-work as plain work, which is covered by well known prices, and then to add the extra mouldings and ornaments at so much per foot, running measure, according to their length. The price per superficial foot of joiners' work is deduced from the quantity of that kind of work which a good and competent workman, with every convenience around him, ought to do in an hour, a day, or any stated portion of time; and in computing the value of such work the labour only is taken into account, without the value of the wood, or stuff consumed. This is called the price for labour only. But when the joiner provides stuff, its value must be added to that of the workmanship, and it is then called the price for labour and materials.—*Millington*.

CARRIER (Common). Persons whose business and employment is carrying goods for hire are called common carriers, as distinguished from those who agree to carry in any particular instances. Carriers are one species of bailees. The material question in the contract relates to the degree of care which the carrier is obliged to exercise. By the civil law he is required to use ordinary diligence, that is, the care and diligence used by a man of common prudence in like cases. The French code follows the civil law very nearly, being, however, a little more strict, as it makes the carrier answerable for the goods, except in cases of superior force, or inevitable accident, or damage arising from the quality of the articles. Down to the time of Henry VIII. the English law seems not to have imposed on the common carrier a greater responsibility than the French code. But, since the time of Elizabeth, he has been held answerable for all losses and damage not arising from the perishable nature of the article, the act of God, as it is called, or of a public enemy. Thus he is answerable for loss by robbers, for which the French code would excuse him. The reason of this strictness is to provide "for the safety of all persons, the necessity of whose affairs obliges them to resort to those sorts of persons, that they may be safe in their ways of dealing; for else these carriers might have an opportunity of undoing all persons that have any dealings with them, by combining with thieves, and yet doing it in such a clandestine manner as would not be possible to be discovered." In regard to the continuance of the responsibility, in a case of the carriage of hops from Stourport to Manchester, and thence to Stockport, they were carried to Manchester by one set of carriers on the canal, where they were stored in their storehouse, until they should be taken by another set of carriers, to be forwarded to Stockport, and, being so stored, were

burnt. The goods were considered to be in the defendants' hands, not in their character of carriers, but in that of warehouse-men; and so they were held not to be liable. Lord Kenyon said, "The case of a carrier stands by itself on peculiar grounds; he is held responsible as an insurer; but I do not see how we can couple the character of a carrier with that of a warehouse-man." In another case against the same company by Hyde, the goods were brought to Manchester, to which place they had been brought and stored in the duke of Bridgewater's storehouse, where they were consumed by fire. The company had charged for cartage from this storehouse to the consignee's store. The goods were, from this circumstance, considered to be in the hands of the defendants, as common carriers; and they were held liable for their value. These cases consider loss by fire as not among the inevitable accidents denominated *acts of God*. The distinction was made upon this point in another case (reported in the 'Term Reports,' vol. i. p. 27), of some bags of hops, which were in the course of transportation from London to Shaftesbury, deposited in a booth at Andover, and destroyed by a fire, which, at first, caught in a neighbouring booth, at a hundred yards' distance. It was said, in this case, if the fire had been occasioned by lightning, the carriers would not have been answerable; but as it was occasioned by the agency or carelessness of man, they were answerable. This risk of fire does not seem to be one which ought to be imposed on the carrier, upon the principle alleged in favour of his answering for a robbery, namely, for the purpose of preventing collusion with the robbers, for there appears to be no reason for collusion with incendiaries. The above cases show that the law of England considers persons employed in transporting goods on a canal to be common carriers. The rule extends, also, to persons employed in inland navigation generally; and some of the old cases appear to extend it to the coasting trade; but there is no question that it is not, under a bill of lading in the usual form, applicable to foreign navigation, the risk from pirates being universally acknowledged to be a "danger of the seas," for which the ship-owner is not responsible. A waggoner or coachman, whose business is carrying for hire, is answerable as a common carrier; and the owners of the vehicle who employ him, are also answerable in the same manner; but they are not answerable for any articles which it is known not to be their business to carry; as when the driver of a coach, intended by the proprietors, and ordinarily used, only for the transportation of passengers, took a box to carry, without the consent or authority of the owners, intending to keep the fare himself, they were held not to be answerable for the loss of the box. A postmaster was held not to be under so strict a responsibility, nor answerable for money enclosed in a letter stolen from his office, for he is a public

officer; but Chief-justice Hale thought he ought to be answerable upon the same principle and to the same extent as a common carrier. A person who undertakes to carry goods in a special instance, though it be for hire, is not answerable, under the English law, as a common carrier; that is, he is not an insurer, but is only bound to use due diligence. So one who carries goods without receiving any compensation is answerable only for the loss and damage occasioned by his negligence or misconduct, and the reason of his being thus far answerable is his undertaking to carry the goods, which are accordingly put into his hands upon the presumption that he will not be guilty of any gross negligence in so doing. Where there is no special stipulation as to the delivery of goods by the carrier, and where the contract is not modified by some very distinct and well-known usage, he must deliver the goods to the consignee, or to some person authorized by him to receive them, and the responsibility of the carrier continues till the goods are so delivered. Where, in attempting to shoot a bridge, the boat was driven, by a sudden gust of wind, against a pier, and sunk, the carrier was held not to be answerable; but where any accident of this kind happens, in consequence of overloading the vessel, or otherwise, by the fault of the carrier, he is answerable; as, where goods were taken to be carried from Hull to Stockwith, and the vessel arrived at Stockwith, where a part of the cargo was discharged, but not the goods in question, which, being stowed under some that were to be carried on to Gainsborough, were left on board, the master intending to deliver them on his return from Gainsborough, but the vessel was run aground, and the goods damaged, in going to Gainsborough, the owners of the vessel were held responsible. The particular circumstances under which goods are taken to be transported, may modify and control the responsibility of the carrier; as where, in time of scarcity, some wheat was taken by a boatman on a canal, to be carried from Wolverhampton to Manchester, on a day of the week on which it was not usual for his boat to go, and for the purpose of removing the wheat from a mob who showed a riotous disposition, he was held not to be answerable for damage done by some of the mob, who seized a part of the wheat, about four or five miles from Wolverhampton. It was held, in this case, that the boatman did not take the wheat as a common carrier. And if the owner of the goods contract with one of the partners in the business of transportation, with a knowledge that he alone is to be benefited, and receive the fare, his partners are held not to be liable. But carriers may limit their responsibility by giving notice of the conditions upon which, and the extent to which, they will be answerable. Thus, where carriers gave notice that they would not be answerable for any package over the value of five pounds, unless entered and paid for as such,

persons sending goods were bound by such notice. And so if they give notice that they will not be answerable for the faults of the master and mariners, provided the notice is so given as to afford ground of presumption of its reaching the party for whom the goods are carried, or in such way that it shall be his fault if he does not receive the notice.—The law relating to the responsibility of carriers has been thus more fully stated than is usual in this work in regard to legal subjects, because it is one of general and popular interest.

CARRIER PIGEON. This bird is a native of the East; and the practice of sending letters by pigeons belongs principally to Eastern countries. The pigeons chosen for this service are called, in Arabic, *hamahn*. They have a ring of particoloured feathers round the neck, red feet, covered with down, and build their nests in the neighbourhood of human habitations. In the province of Irak,—that is, Chaldaea, Babylonia, and Assyria,—white pigeons are trained with the least difficulty. An actual post-system, in which pigeons were the messengers, was established by the sultan Nouredin Mahmoud, who died in 1174. It was improved and extended by the caliph Ahmed Alraser-Lidiv-Allah, of Bagdad, who died in 1225. The price of a well-trained pair of such pigeons was, at that time, 1,000 dinars, that is, Arabic ducats. This flying-post lasted till 1258, when Bagdad fell into the hands of the Mongols, and was destroyed by them. At present only a few wealthy individuals in the East keep these pigeons. It requires much time and patience to train them. As soon as the young—a cock and a hen are preferred—are fledged, they are made as tame as possible, and accustomed to each other's society. They are then sent, in an uncovered cage, to the place whither they are usually to carry messages. If one of them is carried away, after having been well treated for some time, it will certainly return to its mate. A small letter is written on the finest silk-paper, sometimes on a particular kind called *bird-paper*. This is placed lengthwise under one wing, and fastened with a pin—the point being turned from the body—to a feather. It needs not to be mentioned that no part of the letter must hang loose, lest the wind should be collected in it, the wing become tired, and the pigeon be compelled to alight. There were similar posts in Egypt in 1450, for which columbaries were prepared in towers, erected at certain distances for the public security.—This custom is, however, not confined to the nations of the East. Decius Brutus, according to the elder Pliny's account, sent despatches from Modena by pigeons; and in modern times, they were made use of, during the Dutch war, by the inhabitants of Haerlem, when besieged in 1573, and in Leyden, in 1574. It is also well-known, that some merchants in Paris and Amsterdam employ carrier-pigeons, in order that the course of exchange

and the prices of stocks in Paris, may be known as soon as possible in Amsterdam.

CARROT,—botanically *Daucus*. A genus of annual and biennial plants, of the umbelliferous tribe. Two species grow wild in Britain; thirteen have been introduced from foreign countries,—principally the south of Europe; and six other species are known to botanists. The flowers of all the species grow in umbels, and have five obcordate, unequal petals; and the seeds of all grow in pairs, and are unbeaked, and have four rows of flat prickles with intermediate ribs. Four of the species, the shore, the prickly-seeded, the golden-flowered, and the Monte-Videan, are annual weeds of respectively Greece, Barbary, Spain, and South America; and all the other species—excepting the cultivated varieties of the common species—are biennial herbaceous weeds,—one of Cornwall, one of Barbary, and the rest of the south of Europe. The prickly-seeded and the hispid species have pink flowers; the golden-flowered and the small-flowered species have yellow flowers; and all the other species have white flowers.

The common species, *Daucus carota*, concentrates in itself all the true interest of the genus. Its normal form is a mere weed of Britain; but its varieties comprise all the kinds of cultivated carrots of the garden and the field, of Britain and the continent. Its root is hard, fusiform, and biennial; its stem is rough and furrowed; its leaves are tripinnate, with pinnatifid leaflets, and acute, lanceolate segment-lines; its flowers are white, but comprise one red or purplish barren flower, in the centre of each umbel; the umbel, when the seeds ripen, assumes a contracted and concave shape, somewhat similar to that of a bird's nest; and the seeds are provided with slender bristles, which render them easily buoyant in the breeze. The wild plant abounds in gravelly soil, by the sides of fields, at the base of hedges, and athwart the face of pasture grounds, in many parts of Britain. It is popularly called the bird's nest, in allusion to the form of its umbels at the ripening of its seeds; and it differs little in the appearance of its stems, leaves, and flowers, from the cultivated varieties. Its root, however, as compared to that of any of the cultivated varieties, is small, forked, tough, sticky, stringy, hard, woody, disagreeable, and possessed of powerful and almost poisonous properties; and its seeds are used in medicine, and esteemed a good diuretic. Yet though this wild plant is regarded by almost all botanists and cultivators as the origin of the cultivated varieties, other persons than mere novices have great difficulty in not pronouncing it a totally and even widely different species. "The plants of this sort," remarks Miller, "do not differ greatly in appearance from the garden carrot, which has led some persons into an opinion of their being the same; but those who have attempted to cultivate the wild sort for many years, are fully convinced of

their being distinct plants. I have tried to cultivate the wild sort for many years, but could never get the seeds which were sown in the spring to grow; upon which I sowed the seeds in autumn, part of which have come up well; these plants I cultivated in the same manner as the garden carrot, but could not improve the roots in the least, for they continued to be small, sticky, and of a hot biting taste; and this has been always the case, wherever the plants have been sown; therefore there can be no doubt of their being different plants." Rather than believe the cultivated carrot to be a variety of the nauseous wild carrot of our pastures, we may almost suppose it to be identical with some species of far warmer countries, which either has escaped the researches of modern botanists, or has ceased to exist in a wild state.

The cultivated varieties of the carrot are reduced, in systematic botany, to three, the yellow garden carrot, *D. c. hortensis*,—the long-orange carrot, *D. c. aurantia*,—and the early horn carrot, *D. c. præcox*; but they are distributed by seedsmen and cultivators into at least eight distinct kinds, and are sometimes grouped into two classes, the one suitable exclusively for garden culture, and the other suitable for cultivation in either the garden or the field. The principal varieties which suit the garden but do not suit the field are the early horn or Dutch carrot and the short orange carrot; and the principal varieties which suit both the garden and the field are the large orange, the long red, the Altringham, the large white green-top, the common white, and the deep red or the purple-coloured. The orange kinds, particularly the large orange, are generally preferred for field culture in Britain; but the white kinds, particularly the large white, are generally preferred by the farmers of Belgium, France, and other parts of the continent, and are supposed by them both to yield a larger bulk of produce, and to contain a greater proportion of saccharine matter.

The early horn or Dutch carrot is the earliest sort, and is very much esteemed. Its root is smaller than that of any other cultivated carrot; it is of a deep red vermilion colour; it has a very small heart; it is thick and short, and terminates abruptly at the lower end; and it has a hollow crown, and lifts it above the surface of the ground. The stem or neck also is very small, and even the foliage is small. Several subvarieties of this sort are cultivated in Holland and Germany; but they differ from the small horn carrot of Britain only in having a lighter colour in the root, or shades between yellow and crimson, instead of deep red vermilion.—The short orange carrot is of excellent quality, but, as yet, is not much known. Both the earliness of its habit, and the shape and size of its roots, are intermediate between those of the early horn and those of the large orange.

The large orange carrot, or simply the orange,

though quite common in cottage gardens, is so generally selected by British farmers for field cultivation as often to bear the names of cattle carrot and large field carrot. Its root is long, thick at the upper end, and regularly tapering to a point; it has a rather large heart; it is of somewhat orange or light reddish vermilion colour; it lifts its crown scarcely, if at all, above the surface of the ground; and, though eminently adapted for feeding cattle, and by no means unsuited to the use of man, it is too coarse for the table of the fastidious.—The long red or long Surrey carrot has a deep red colour, and a comparatively smaller heart than the large orange carrot, and is much less thick in proportion to its length.—The Altringham carrot is eminently suitable for both the garden and the field; but, in consequence of a strong constitutional tendency to sport itself into new and deteriorated subvarieties, it is much more difficult than any other variety to be obtained genuine. Its root has a smaller heart than the large orange carrot; it resembles that variety in colour; and it differs from both the large orange and the long red in having a more convex or rounded head, in lifting this more above the surface of the ground, in tapering with less regularity, and in making a more abrupt termination at the lower end.—The large white green-top carrot was not long ago brought into notice in France, yet is now extensively cultivated. Its root is large and proportionally thicker than long; it is white underground, but green on the top; and it lifts its crown considerably above the surface of the ground. This variety has the important recommendation of being suitable for soils which are too shallow for the proper growth of other varieties.—The common white carrot, or simply the white carrot, is of an inferior quality, and does not deserve the attention of either the gardener or the farmer. Its root is smaller in size, more tapering in shape, and proportionally thicker in heart than that of the large white green-top carrot; and it does not lift its crown above the surface of the ground.—The red, deep-red, or purple-coloured carrot is supposed to be better suited to marshy or otherwise wet soils than any other variety; and is sometimes cultivated on such soils in France. Its root has a deep reddish purple colour, and a comparatively large yellow heart; and, though proportionately very long, it is of smaller size than the roots of most of the other varieties.

The garden cultivation of carrots, though attempted in almost all gardens, from the smallest cottage plot to the kitchen garden of the palace or the fields of the market gardener, is, to a great extent, characterized by signal failure. Yet the carrot crop is as sure an one in farm-fields as any other; and, with a very ordinary degree of knowledge and care, might be uniformly and even eminently successful in almost every garden. The best soil for it is a warm, light, sandy loam,

not less than two feet deep; but any soil which is friable, pulverulent, free from recent manure, comparatively free from vegetable excretion, and sufficiently deep, will suit. The finest sandy loam, though it were a yard deep and in the finest tilth, if it be charged with the excretions of many previous garden crops, and in consequence overrun with the eggs of minute insects, may not be able to bring a single carrot crop to perfection; and a deep adhesive loam, so stiff and clayey as to be utterly unpromising, if it be recently recovered from a long period of grass, and rendered properly porous by the intermixture of arenaceous or other loosening matter, may bring all the plants of a crop to a healthy and even gigantic maturity. The great preventives of success to carrot culture in gardens are recent manure and a profusion of the eggs of insects; and the former of these is to be averted either by relying wholly on the manure of some previous year, or by using only the most finely divided old simple manure in a state of intimate intermixture with the soil; and the latter, in the case of ground which has been long under garden crops, is to be averted by such a special manner of trenching as to bury nine or ten inches of surface-stratum of the soil at least two feet deep, to cover it over with a thin coat of some caustic matter which will prevent the worms of its insect's eggs from ascending out of it, and to constitute all the new surface and central strata of matter as nearly as possible resembling virgin soil. Fresh manure in carrot-ground causes the plants to fork; and even well-rotted dunghill manure, when added year by year to any spot of ground, speedily renders it so replete with minute worms as to be ruinous to carrots. Whatever garden soil has become foul with the eggs of insects is certain, if sown with carrots, to surrender the young, soft, succulent, saccharine roots of the crop as the choicest of all food to its insect multitudes. To trench such soil in the ordinary manner is not to place its insects' eggs beyond the vivifying influence of air and heat, but merely to disperse them through the uplifted subsoil; and hence the necessity of carefully burying it all at the bottom of a deep trenching, of treading it down into its bed, and of sealing it over with such a mixture of quicklime and sand as will lie like a sheet of mortar between it and the new soil.

The selection of seed for the garden sowing of carrots, the mode of preparing it for sowing, and some points of culture and harvesting will be fully indicated in what we have afterwards to say respecting field-carrots. The garden ground for carrots may either be disposed in drills a foot asunder for drill-sowing, or in beds not more than four feet wide for broadcast-sowing. In the latter case, it ought, before sowing, to be laid perfectly smooth, and, before raking, to be gently trodden. The seed, if good, should be sown thin; and the young plants, when they attain a due

height, should be thinned out to distances of from three to eight inches, according to the season of the crop, and the intention of drawing them for use when small, when middle-sized, or not till full-grown. The different kinds of carrot, early and late, horn and long, may be sown in such succession as to afford small and middle-sized roots for use in March, April, May, June, and July, large roots in August and September, and full-grown roots of the greatest size in October, and thence, if they be properly stored in sand, throughout the winter. Small crops for young roots in late spring and early summer, are sown in January and February; main crops in March and April; successional crops of young roots, in May, June, and July; and crops for the earliest young roots of spring, in the beginning of August. The January sowing should be made on a moderate hotbed, and the February sowing on a warm border; the chief main crop may be most advantageously sown from the first till the tenth of April; and the crop which is sown in the beginning of August and stands over the winter must, in all frosty weather, be sheltered with a covering of litter.

The best soil for the field growth of carrots is a loose, sandy, friable loam, of at least eighteen inches in depth; and hence the light and fertile sands of Suffolk, Norfolk, and Surrey have been longer and more extensively used as field-carrot ground than any other equal extent of land in Britain. But poor soft sand, which is scarcely able to produce any other crop, provided it be deep enough, may be quite suitable for carrots; and, in some instances, land of this light, worthless, barren sort, has made a most magnificent return of carrots, when all the best loams of all the gardens of the surrounding district have brought scarcely one root to maturity. Soils of almost any kind are suitable which possess the requisites of depth, openness, and perfect freedom from stones. Even drained peat soil of proper depth is well fitted to produce sure and excellent crops. Carrots require rather mechanical than chemical fitness in soils; and if permitted to shoot down their roots unobstructedly and freely to the utmost depth which they have organic power to attain, and to spread freely and far around the slender hairy, filiform radicles which contain the minute spongioles for the absorption of their food, they can readily afford to want a very large proportion of the elements of nutrition which are essential to most other crops; and even when these elements are present in the soil,—such as those which form the nitrogenous seeds of the cereal grasses, and the vitreously saline coating of their culms,—the carrots leave them where they find them, almost totally unabsorbed. A crop of barley after carrots, provided no impoverishment be permitted by weeds, will be quite as good, or within a mere trifle of being quite as good, as if taken instead of the carrots, and without their intervention. Carrots, more than most

other crops, elaborate their substance out of the gases and moisture of the atmosphere; in particular, they form the whole of their saccharine matter out of atmospheric sources; and as this matter, though not so great in the percentage of each root as in beet, is exceedingly great in its aggregate produce per acre, carrots might be grown merely for sake of their sugar; and if all their stems and foliage, and all the refuse of their roots from the sugar manufacture, were carefully returned to the soil, they might be raised year after year, in all the successive years of a century, upon one field, without exhausting it of one particle of its fertility. The conjecture may seem to even scientific farmers exceedingly chimerical—yet in these days of rapid and vast improvement in legislation, in agricultural chemistry, and in scientific geology, it is by no means improbable—that a large portion of the bogs of Ireland, at present so worthless and dismal, may, in the course of two or three decads, be regularly cropped with carrots, and yield to Britain an incomparably richer supply of sugar than she has ever yet obtained from the fertile and beautiful cane plantations of the West Indies.

The use of manure, in the field cultivation of carrots, has been the subject of much debate, and does not seem, as to the principle of it, to be well understood; yet, in the best carrot-growing districts of England, it is generally and even profusely practised. Some agriculturists contend that no manure whatever should be given, and that the ground should as nearly as possible be in the condition of virgin soil; some, that rich manuring of the previous year should provide for the carrot crop; some, that fresh manure should be so applied as to lie buried at the depth of sixteen or seventeen inches, to yield its influence to most of the growth only in the form of ascending gas and vapour, and to sustain contact with the tips of the roots only when they are close upon maturity; and some, that fresh manure should be applied in the manner of thorough intermixture with the soil. Experiment certainly seems to prove that, acre per acre, the produce of richly manured carrots is bulkier than the produce of carrots upon unmanured soil. One experiment, for example—though it is decidedly an extreme one in favour of manure—exhibits the produce per acre of manured carrots at twelve tons of roots and five tons of tops, and that of unmanured carrots at nine tons of roots and four tons of tops. Arthur Young even employs such strong language as the following: “If you would command your crops of this root, you should manure the land with twenty-five or thirty loads of dung per acre, pretty rotten, ploughed in, and then cover the seed by harrowing. The dung neither injures the taste of the carrots, makes them grow deformed, nor causes the canker. A farmer’s object is to produce as great a quantity as possible from every acre, which must undoubtedly be accomplished by manure.” But if dung

be applied in any such manner or to any such extent as Mr. Young recommends, it must certainly be thoroughly decomposed and so “short” as to admit of perfect and even pulverulent intermixture with the soil. Any farm-yard manure which is “long,” or not completely decomposed, will certainly make the roots fork, and probably subject them to the attacks of the worm, and possibly render such as otherwise escape ill-flavoured and unfit for either culinary or market use. The Suffolk and Norfolk farmers, who have long had the fame of being the best carrot-growers of Britain, but who generally operate upon a soil of peculiar mechanical conditions, always turn in a suitable proportion of well-rotted farm-yard dung, at the March ploughing immediately before the sowing of carrots; and, though few seem to have raised the question, still less to have tested it, they probably owe the acknowledged beneficial effects of the practice, fully more to the mechanical action of the manure than to its supposed chemical influence. Burrows, an intelligent Norfolk farmer, who, in a communication to the Board of Agriculture, gave one of the best statements on field carrot culture which has ever appeared in print, always prepared his carrot-land with a dressing of about sixteen cart-loads per acre of cottagers’ ashes or of well-rotted farm-yard manure,—each load having been as much as three strong horses could draw; and he usually selected as his carrot-land wheat-stubble after clover, ploughed it first in autumn and next in February, and both laid on the manure and sowed the seed in the last week of March or in the first or second week of April. In Suffolk, carrot-land after pease is usually ploughed as soon as the pea-crop is harvested; and in December, it is laid up in small balks, to be mellowed by the frost; in February, it is harrowed down, manured with farm-yard dung at the rate of fifteen loads per acre, and has the manure ploughed in to the depth of about four inches; and, in the latter part of March, it is double-furrowed and sown. In Norfolk, land for carrots is usually selected after turnips; in the beginning of March, it is first manured, next ploughed with a common plough, and next trench-ploughed to the depth of fourteen or fifteen inches; and in the middle or latter part of March, it is very finely harrowed, and then sown. In Brittany, the preparation of carrot-land is effected by the joint operations of the spade and the plough, and by a combination of the resources of several farms. “The different farmers join to bring as many labourers together as will dig out a furrow as rapidly as the plough can draw it: they divide the whole length of the field equally among them. As soon as the plough has made a furrow, the men trench the bottom of it with their spades nine or ten inches deep, throwing the earth over the furrow-slice last turned; on the return of the plough, the next slice is turned into the deep trench, and immediately covered by the spades

as before. Thus an acre is readily trenched in one day to the depth of fifteen or eighteen inches, and all the weeds are buried: carrot or parsnip seed is sown on the surface and slightly harrowed in." [Rham's Dictionary of the Farm.]

Carrot seed, selected for sowing, ought to be ripe and heavy; yet if two or even three years old, will vegetate as well as if quite new. Great care should be used in selecting good seed; and when much nicety is desirable, only such seeds as have grown on the outer border of the umbel should be chosen. The seed is extremely light, adheres in groups by means of hooked hairs which spring from its husks, and, if not somewhat forced before sowing, is so very long in germinating as to be preceded and sometimes almost choked by weeds. Its lightness requires that it should be sown in calm weather, and during a somewhat dry condition of the soil. Its strong adherence into knots and bunches by means of its hooked hairs, requires that, previous to sowing, it should be well mixed with fine dry sand; and even then, this property renders the proper sowing of the seed in drills very difficult, and occasions the young plants to come up in tufts, and often at too great intervals. The slowness of the seed's germination may, by a very easy method of previous forcing, be so greatly quickened as to let the young plants rise in ample time to make a successful contest with weeds, and to be hoed without risk of injury. The method is to add so much water to the mixture of seeds and sand as will thoroughly moisten it, to place it in a moderately warm temperature, and, during from ten to twenty days, daily to turn it over and make fresh sprinklings upon it of water. Burrows, who fully tested this method, and brought it into notice, says, "Having weighed the quantity of seed to be sown, and collected sand or fine mould, in the proportion of about two bushels to an acre, I mix the seed with the sand or mould, eight or ten pounds to every two bushels, and this is done about a fortnight or three weeks before the time I intend sowing; taking care to have the heaps turned over every day, sprinkling the outside of them with water each time of turning over, that every part of the sand heaps may be equally moist, and that vegetation may take place alike throughout. I have great advantage in preparing the seed so long beforehand; it is by this means in a state of forward vegetation, therefore lies but a short time in the ground, and, by quickly appearing above ground, is more able to contend with those numerous tribes of weeds in the soil, whose seeds are of quicker vegetation."

The earlier in the spring carrots are sown, provided the weather be dry and the climate mild, the larger will be the crop, and the better the quality of the roots. About the middle of March is usually the best time in the southern counties of England; but the middle of April, or even the latter part of that month, may be early enough

in some good farming districts in the north of England and the south of Scotland. If the decided goodness of the seed can be depended on, two pounds per acre may be sufficient in drills, and between four and five pounds broadcast; but if the quality of the seed be in the least degree doubtful, the double of each quantity ought to be sown. Burrows always sowed ten pounds per acre broadcast. When the land is dry, rather more seed is required than when the land is moist. The drill method of sowing is greatly preferable for the facility of weeding; but, on account of the peculiar character of the seeds, it cannot easily be practised. The drills may be fourteen or fifteen inches distant from one another; and the seed may be deposited either by a machine or by hand. The broadcast method is generally practised in all carrot-growing districts; and it simply requires a finely powdered soil, a smooth surface, and a very light harrowing-in.

The after-culture of the carrot-crop consists wholly of hoeing and weeding. Though the plant has the appearance of obtaining its chief nourishment from the lower end of the root, yet, on account of the multitudinous minute radicles which grow horizontally from every part of the root, and on account especially of its acquiring so large a portion of its bulk from the free circulation of the atmospheric gases and moisture, it receives very great advantage from judicious and repeated stirring of the soil. When the crop is sown on raised drills, the hoeing and cleaning may be effected in the same manner as in turnip crops; and when sown in flat drills, they must be thinned, cleaned, and hoed with the hand-hoe. When the crop is broadcast, three or perhaps four hoeings must be given in the season, each with a size of hand-hoe suited to its precise object, and the first with extreme care, as the carrots cannot, without difficulty, be at that time distinguished from accompanying weeds. The first hoeing, in Burrows' method, occurs about five or six weeks after sowing, and cuts up weeds without thinning the carrots, and is performed with hoes four inches long and two and a quarter inches wide; the second hoeing is given as soon as the first is completed and the plants are set, and is performed with hoes six inches long, and two and a quarter inches wide; and the third and fourth hoeings effect the complete and final cleaning of the ground, and the thinning out of the plants to distances from one another of from nine to twelve inches. In Suffolk, the first hoeing is given as soon as the carrots can be distinguished from weeds, and is performed with three-inch hoes, having handles of not more than two feet in length; the second hoeing is given three or four weeks after the first, and is performed with common hoes, and not only takes up weeds and stirs the ground, but thins out the carrots; and the third or final hoeing is given about the middle or end of June, and, besides destroying weeds, effects such a final thinning as to leave all the carrots

at distances from one another of from eight to eighteen inches.

The stems and foliage of the growing crop are, in many localities, cut off as food for cattle and sheep, and certainly constitute a sweet, delicate, and much relished fodder; but the loss of growth to the roots unavoidably consequent upon the removal of the leaves, is of far more value than the provender obtained; so that the stems and foliage ought never to be removed till the roots are matured, or till they themselves begin to droop, and their outermost leaves to wither. The common time of taking up the crop is the last week of October; but the tops may be mown as soon as they begin to droop, and the roots left in the ground till the near approach of winter's frost. The plough, deprived of its coulter, has sometimes been employed for unearthing the roots; but, in spite of the utmost care which the ploughman can use, both the plough and the horses which draw it bruise and otherwise damage a considerable proportion of the crop. A three pronged fork, such as is used for digging asparagus beds, with bluntly-pointed and roundly-edged prongs, is the most suitable instrument; and this, when stuck vertically down by the side of the rows, and then pressed diagonally on the handle, brings up the roots in sound, unscratched condition. Burrows let the work of raising the roots to a man, who hired women and children as assistants; and he says, "I take up in autumn a sufficient quantity to have a store to last me out any considerable frost or snow that may happen in the winter months; the rest of the crop I leave in the ground, preferring them fresh out of the earth for both horses and bullocks. The carrots keep best in the ground, nor can the severest frosts do them any material injury; the first week in March it is necessary to have the remaining part of the crop taken up, and the land cleared for barley. The carrots can either be laid in a heap with a small quantity of straw over them, or they may be laid into some empty out-house or barn, in heaps of many hundred bushels, provided they are put together dry. This latter circumstance it is indispensably necessary to attend to; for if laid together in large heaps when wet, they will certainly sustain much injury. When selecting such as I want to keep for the use of my horses until the months of May and June, in drawing over the heaps (which should be done in the latter end of April, when the carrots begin to sprout at the crown very fast) I throw aside the healthy and most perfect roots, and have their crowns cut completely off and laid by themselves; by this means, carrots may be kept the month of June out in a high state of perfection." But when carrots are to be followed by wheat, as well as in some other cases, all require to be raised at the end of autumn; and in such instances, they may easily be preserved throughout the winter, either in dry cellars, or in long trenches, covered with straw, in the manner of beet, turnips, &c.

The average produce of carrots is perhaps from fifty to seventy-five per cent. more than the average produce of potatoes. The produce of an acre of carrots in Suffolk is usually between 300 and 400 bushels; but the average produce per acre of the crops raised by Burrows was upwards of 800 bushels. The produce of an experimental crop of white or Belgian carrots, on a farm near Exeter in 1842, was at the rate of rather more than 30 tons per acre; and the relative produce of experimental crops of Belgian white carrots and Altringham red carrots, in the same year near Tockington, was 20 tons of the white and 16½ tons of the red. An experimental crop of Belgian white carrots, at Chester Hill in 1840, yielded at the rate of 26 tons 3 cwt. per acre; and an experimental crop of early horn carrots, in the same year on stone-brash soil in the table-land of Frocester Hill, on the estate of Lord Ducie, yielded at the rate of 18½ tons per acre.

The culinary uses of carrots for soups, for stews, for haricots, for boiling whole with beef, and for other methods of cookery, are too well known to require any remark.—The availability of carrots for the manufacture of sugar has already been noticed. The expressed juice of carrots, in consequence of the large proportion of sugar it contains, yields, after fermentation, and through the process of distillation, so large a quantity of spirituous liquor as twelve gallons of spirit for every ton of carrots. The quantity of nutritive matter in carrots, according to an analysis by Sir Humphrey Davy, comprises 0·3 per cent. of starch and 9·5 per cent. of sugar.—Clater places carrots among cattle medicines, and says, "These are inserted in the list of drugs, because they contain the best medicine that can be given, either when the animal is slowly recovering from severe illness, or when he has much cough, or considerable humour or foulness about him."—Boiled carrots are readily eaten by poultry; and, when mixed with any farinaceous substance, they constitute as excellent feeding as poultry can obtain.—Boiled carrots, especially if accompanied with some other kinds of food, are the best aliment for fattening hogs; and were preferred for that purpose, by Arthur Young, to pollard, white pease, buckwheat, or potatoes.—Carrots are used in the dairy, during winter and spring, for giving colour and flavour to butter; and, when this object is specially desired, they certainly form better feeding for milk-cows than any other description of green food.

But the grand use of carrots on a farm is for strengthening and medicinal food to horses and working oxen. Carrots are readily eaten by horses, and, in some instances, are preferred by them to oats; and when given to them with cut straw and a little hay, without any corn, they maintain the horses in excellent working condition, and very visibly improve the glossy and healthy appearance of their coat. Nor do they merely give strength and endurance to sound

horses, but they also give recovery and health to such as are sick. "The carrot," says Stewart, in his *Stable Economy*, "is held in much esteem. There is none better, nor perhaps so good. When first given, it is slightly diuretic and laxative; but as the horse becomes accustomed to it, these effects cease to be produced. They also improve the state of the skin. They form a good substitute for grass, and an excellent alterative for horses out of condition. To sick and idle horses, they render corn unnecessary. They are beneficial in all chronic diseases connected with breathing, and have a marked influence on chronic cough and broken wind. They are serviceable in diseases of the skin; and in combination with oats, they restore a worn horse much sooner than oats alone." Most carrot-growing farmers usually give carrots to their horses from about the middle of December till the beginning or middle of May; and many, for a few weeks after commencing the use of them, give only one half of the proper quantity, and make up the difference with corn. The common allowance is between forty and fifty pounds a-day to each horse. Burrows says, "I begin to take up the carrot-crop in the last week of October, as at that time I generally finish soiling my horses with lucern, and now solely depend upon my carrots, with a proper allowance of hay, as winter food for my horses, until about the first week of June following, when the lucern is again ready for soiling. By reducing this practice to a system, I have been enabled to feed ten cart-horses throughout the winter months for these last six years, without any corn whatever, and have at the same time effected a considerable saving of hay, from what I found necessary to give to the same number of horses, when, according to the usual custom of the country, I fed my horses with corn and hay. I give them to my cart-horses in the proportion of seventy pounds weight of carrots a-horse per day, upon an average; not allowing them quite so many in the very short days, and sometimes more than that quantity in the spring months, or to the amount of what I withheld in the short winter days. The men who tend the horses slice some of the carrots in the cut chaff or hay and barn-door refuse; the rest of the carrots they give whole to the horses at night, with a small quantity of hay in their racks; and with this food, my horses generally enjoy uninterrupted health. I mention this, as I believe that some persons think that carrots only, given as food to horses, are injurious to their constitution; but most of the prejudices of mankind have no better foundation, and are taken up at random, or inherited from their grandfathers. So successful have I been with carrots, as a winter food for horses, that, with the assistance of lucern for soiling in summer, I have been enabled to prove by experiments conducted under my own personal inspection, that an able Norfolk team-horse, fully worked two journeys a-day,

winter and summer, may be kept the entire year round upon the produce of only one statute acre of land. I have likewise applied carrots with great profit to the feeding of hogs in winter, and by that means have made my straw into a most excellent manure, without the aid of neat cattle."—*Communications to the Board of Agriculture*.—*Stewart's Stable Economy*.—*Sir John Sinclair's General Report of Scotland*.—*Kane's Industrial Resources of Ireland*.—*Young's Farmer's Kalendar*.—*Quarterly Journal of Agriculture*.—*Journal of the R. Agricultural Society*.—*Lawson's Agriculturist's Manual*.—*Hunter's Georgical Essays*.—*Miller's Dictionary*.—*Low's Elements of Agriculture*.—*Sproule's Agriculture*.—*Rham's Dictionary of the Farm*.—*Loudon's Works*.—*Mauve's Gardener's Calendar*.—*Knowledge Society's British Husbandry*.—*Davy's Agricultural Chemistry*.—*Clater's Cattle Doctor*.—*The Society of Gentlemen's Complete Farmer*.

CARRUCATE. An ancient English measure of land. It comprised as much as a single plough or team could work in a season; and, of course, was indeterminate in quantity, or modified partially by the strength of the team, and very greatly by the quality of the soil.

CARSE. A deep, argillaceous, low, level expanse of alluvium. The names carse and haugh are peculiar to Scotland, and cannot easily be translated into English; though both are frequently, yet most incompetently, represented by the word meadow. A haugh is a lacustrine formation, in a hill-locked valley, and became dry land by the bursting of the lake or the wearing down of the river-course which formed the lake's outlet; and a carse is a marine formation, in the basin or valley of an estuarial river, and became dry land by the slow and gradual subcession of the sea or the filling up of the bottom and basin of the estuary. Haughs are of all sizes, from a few perches to several hundreds of acres, and consist of very many varieties and depths of alluvial soil; but the principal carses are many miles in extent, and consist of very fine and exceedingly deep argillaceous alluvium. But carse clay widely differs from the plastic, pasty, infertile clay of the clay districts of England; and, in consequence of the intimate intermixture of other finely pulverized earths with its argil, possesses eminent adaptation, under good culture, for the production of wheat and beans. The carse of Gowrie along the estuary of the Tay, and the carses of Stirling and Falkirk, along the quondam estuarial portion of the valley of the Forth—both tracts of great extent and of surpassing agricultural beauty—are justly celebrated as the richest grain districts in Scotland.

Carse farms are wholly and most productively arable; and are, in consequence, totally unsuited to pastoral farming. A carse farmer ought to be thoroughly acquainted with the cultivation of grain, but requires little knowledge of the management of live-stock. He needs only horses

for his teams, a few milk cows for the dairy supply of his own establishment, and a few black cattle in winter for treading his straw into manure; and he purchases the cows and the straw-treaders, just when they are needed, and sells them as soon as they have served their temporary purposes. His farm-stead contains but meagre and secondary accommodation for live-stock; yet, as a main object is the conversion of the enormous quantities of straw into manure, the stables and the cattle-yards ought to stand in immediate juxtaposition with the straw-barn. Much of the management of his farm, particularly during winter and spring, consists in efficient surface-draining, to prevent the stagnation of water upon its retentive or slowly-percolating soil; and wherever covered drains for absorbing and carrying off surplus water may be thought unsuitable, the spade must be diligently applied, after every heavy fall of rain, for clearing and scouring the furrows. Grass is grown on but a small proportion of a carse farm; and, even when grown, it remains only one year, and is used wholly for forage. The rotation of crops, and the whole system of grain husbandry, must, of course, be modified by reference to the peculiar nature of the soil, and ought to be regulated with a view to a maximum produce of wheat.

CART. A two-wheeled carriage, drawn generally by one horse, but sometimes by two, and used for the conveyance of all kinds of heavy articles, whether on the farm or on the highway. Carts are exceedingly various in construction; and while some kinds derive their peculiarities from specific adaptation to particular purposes, others derive them from caprice, custom, or bungling contrivance. The waggons so common in most of the agricultural districts of England are often, but improperly, termed carts, and will be noticed in the article *WAGGON*; and two vehicles, the slide car and the Irish car, though not in themselves carts, are used instead of them, and may here be briefly noticed.

The slide-car or drag-cart has some resemblance to the body of a cart without wheels; it is used in mountainous districts of Wales and Scotland, where roads do not exist, and where wheels would be of no service; and it may be regarded as the original or typical form of the cart group of vehicles. "It consists of two strong poles from twelve to fifteen feet long, connected by cross pieces fixed at right angles to them, by mortising or pinning, so that the poles may be two or three feet apart. About eighteen inches of the poles project beyond the lowest cross-piece, the ends resting on the ground. The other ends of the poles form the shafts for the horse to draw by. The load is placed on the cross pieces, over which boards are sometimes nailed, for the purpose of carrying stones, or such things as might fall through between the cross bars: it then resembles the body of a cart taken off the wheels. The horse bears one end of the drag-cart by a strap

over his back, and drags it on by means of a common cart-collar or a breast-strap. This vehicle is extremely useful in steep and rough descents, especially to draw stones from quarries, and can be made of rough poles at little or no expense. Pieces of hard wood fixed under the ends of the poles, and renewed as they wear out, will prevent the ends of the drag-cart from wearing away, and will allow it to slide along more easily."—[*Dictionary of the Farm.*] This simple vehicle is very effective in conveying peats from the highland bogs, and in conveying home hill-harvestings over rugged or very uneven ground; and, in some instances, it is furnished at the extremity of its shafts with a pair of low timber wheels in lieu of the ordinary wooden slippers.

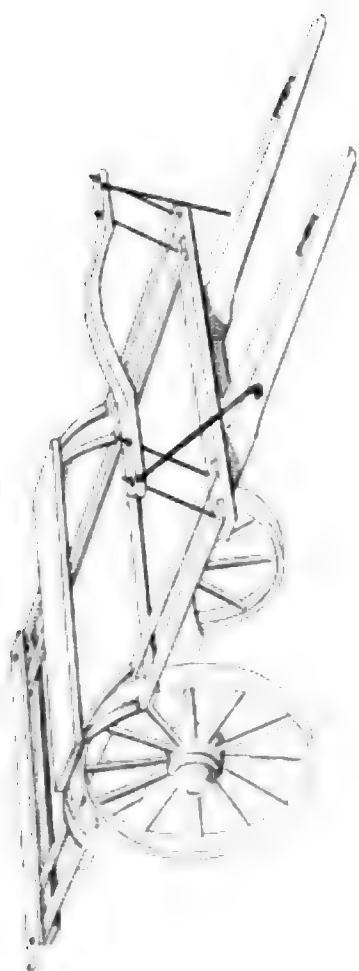
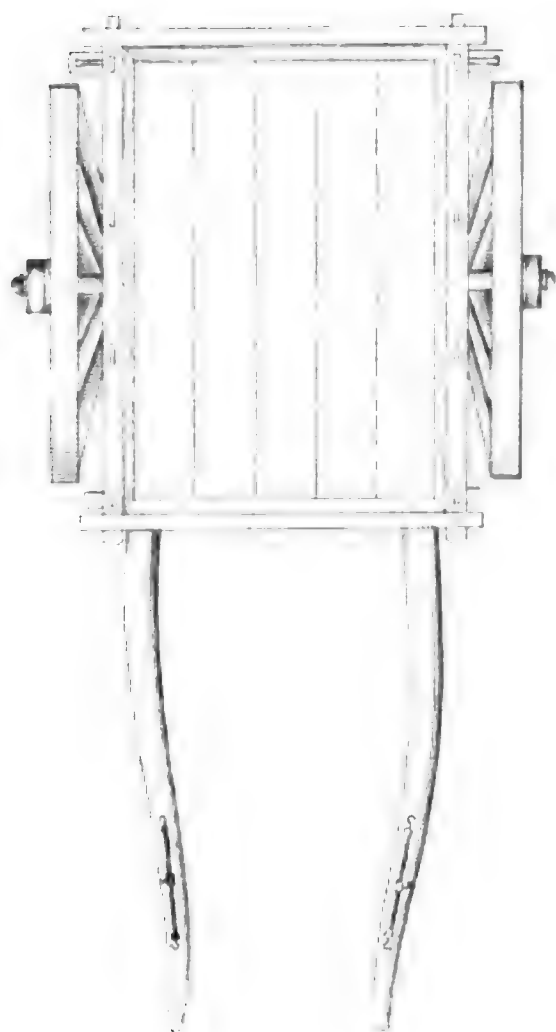
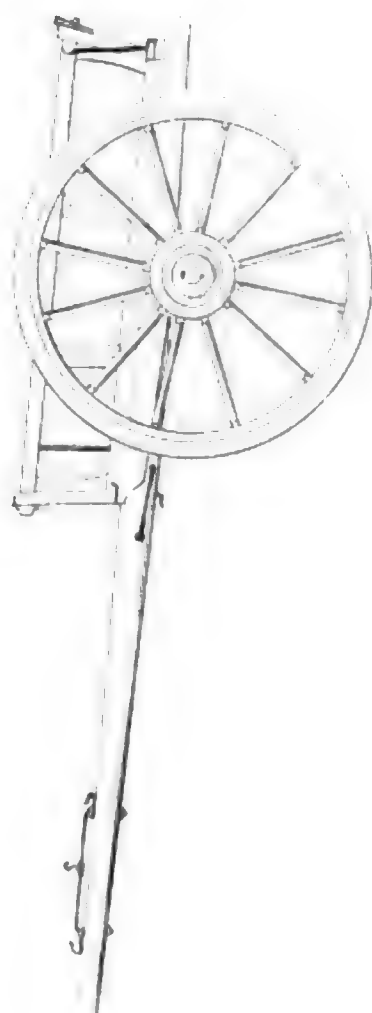
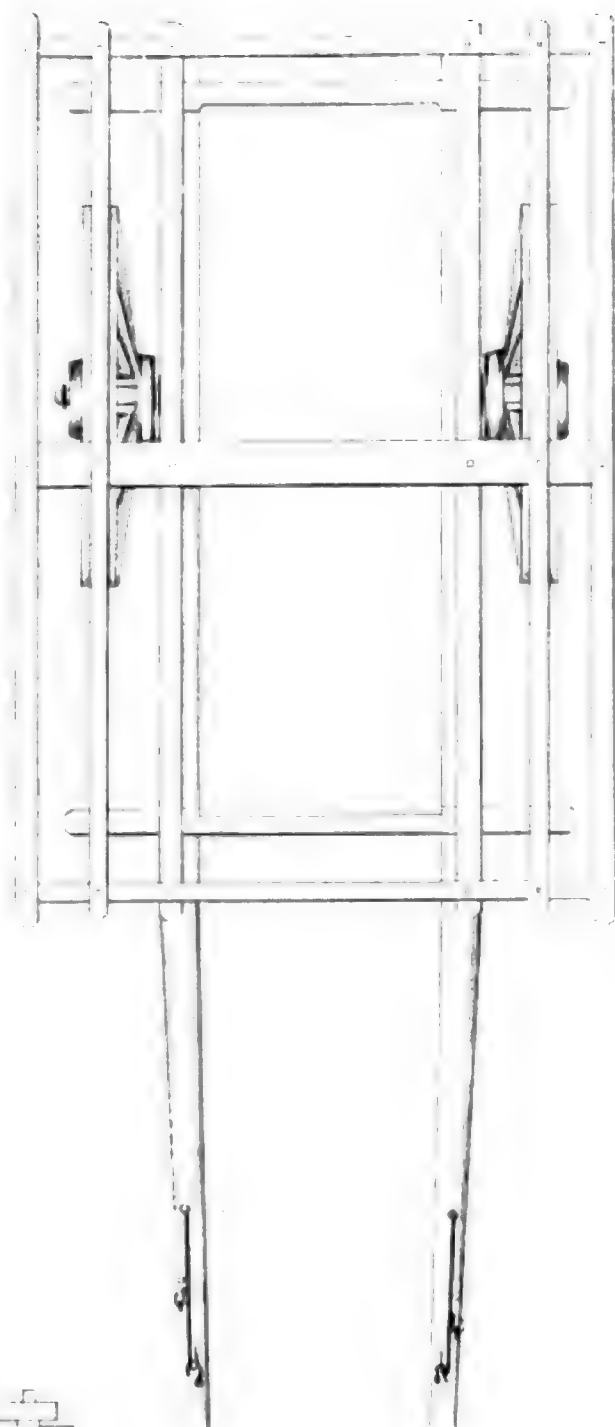
The Irish car consists of a platform, two shafts, and a pair of wheels; with the last so adjusted as to move beneath the platform in the same manner as those of a railway carriage. The platform, in some instances, is horizontal; and in others, is oblique and raised behind, so as to hold what the Irish call a kish. Blocks of wood are fixed below the middle part of the platform, and are bored in their lower part with holes to admit the ends of the axle, so as to let the wheels revolve below the platform. The simplest and most common kind of wheels are circular disks of wood, formed either by a junction of blocks or a nailing together of pieces of plank, and sawing them into circular outline. Iron tires are fixed on the periphery of the wheels; the axles are sometimes bars of iron, but far more commonly beams of wood, and are made tight to the wheels; and two iron pins or strong nails are driven obliquely into the blocks so as to keep the axles in their place. Cars for conveying lime or manure have a boarded platform and a frame, and are called box-cars; and some of this description, constructed in an improved or superior manner, with four-spoked wheels, were used in Leicestershire by Bakewell, and may occasionally be seen in some other parts of England. The Irish car, in any of its ordinary forms, is recommended by its great cheapness, its facility of being laden, its adaptation to the light, low horses of Ireland, its suitableness for mountain roads, and its very small liability to overturns or collisions; but it has the serious disadvantages of small capacity of load, small facility of unloading, and great difficulty of making a rapid curve or sudden turn in the direction of its motion.

The tilt-cart, coup-cart, or common Scotch cart, is by far the most important vehicle of its class in Scotland, and has, for some time past, been rapidly finding its way into favour in England, and, if fairly considered as to the great aggregate of its advantages and adaptations, must be regarded by every person as the most suitable draught-vehicle for all ordinary farms in almost all parts of the world. In the lowlands of Scotland, it is employed for nine-tenths of all the carriage on farms, or connected with agriculture.

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The tire cart... has been found to
be by far the most important...
and has been...
rapidly spreading its way into...
its advantages and adaptation...
is being every where as the...
... which is...
of the world. In the...
it is employed for transportation of...
carriage on farms or near road with...

Scale of Feet 100 200 300



throughout the year; and it has been found, after long and general trial, to possess eminent adaptation for conveying all kinds of solid manure, for carrying stones and other materials required in the operations of draining, for conveying all sorts of produce to market, for carrying home potatoes and turnips, for conveying all other articles which can be properly discharged by tilting, and, with the addition of a harvest frame, for carrying home hay, sheaf-corn, cut grass, cut vetches, and field pease and beans. It admits of much variety of construction, as to at once wheels, shafts, body, and fixedness or removeableness of sides; and it derives its name and distinctive character from the circumstance of its buck or body being so hung upon a bar-pivot, and fastened with a moveable bolt to the front cross-bar of the frame, that, on the withdrawal of the bolt, it can be 'couped' or tilted, so as, with a single jerk, to discharge the whole of its load. In a tilt-cart of ordinary construction, the length of the body at bottom is 5 feet, the length of the body at top is $5\frac{1}{2}$ feet, the breadth of the body at bottom is 3 feet 10 inches, the breadth of the body at top is 4 feet 4 inches, the depth of the body is 3 feet 8 inches, and the diameter of the wheels is 4 feet 6 inches; and in one of smaller size, adapted almost exclusively to home cartage on the farm, the length of the body at bottom is 4 feet 2 inches, the length of the body at top is 4 feet 8 inches, the breadth of the body is $3\frac{1}{2}$ feet, the depth of the body in front is $14\frac{1}{2}$ inches, the depth of the body in rear is $13\frac{1}{2}$ inches, and the diameter of the wheels is 3 feet 10 inches. In every tilt-cart of good construction, the body rests by means of bolsters upon the axle; the shafts are jointed to the axle by means of a rod, which passes through their ends and through the bolsters; the axle is of the bent order, with $2\frac{1}{2}$ inch arms; the wheels are of the dished form, and have a cylindrical tread or sole, and are so far inclined from the vertical as to bring them to the standard gauge below; and the shafts are about 9 feet 2 inches in total length, or about $6\frac{1}{2}$ feet for the yoke, and have large staples on their upper surface for effecting the attachment to the horse's harness. In *Plates XI. and XII.* will be found various drawings to illustrate the construction of the ordinary tilt-cart. The framing is represented in *Fig. 1*; a bird's-eye view of it, in *Fig. 2*; a profile of it upon the axle, in *Fig. 3*; and a back-end view of it, in *Fig. 4*.

A two-horse tilt-cart differs from an ordinary one principally in being stronger, deeper, and larger, and also in readily serving as a hay-cart. A plan or horizontal view of a cart of this kind, fitted with frames as a hay-cart or corn-cart, is shown in *Fig. 5*; a profile of it, in *Fig. 6*; and a back-end view of it, in *Fig. 7*. But in a two-horse cart, the hind-horse bears all the weight which lies before the centre of gravity, the fore-horse, whenever his line of draught is not from the hook of his collar to the centre of the axle,

continually pulls the hind-horse downward, and the two horses are variously liable to act as conflicting rather than as conjoint powers. Now, in order to make the efforts of the two horses coincide, two iron frames, each with a sheeve or whorl, and represented in *Figs. 8 and 9*, are fixed into the axle, as at A, *Fig. 6*; and upon the sheeves of these frames, passes a rope or chain, BAC, same *Fig.* In the outside of each shaft is fixed a long iron staple, as DE, *Figs. 5 and 6*; and on each staple is placed an iron slider, as BD, *Fig. 6*, having liberty to shift either forward or backward from B to E. The chain from the collar of the hind-horse is hooked into the eye of the slider at B; and the chain or rope by which the fore-horse draws, passing from his collar at C, *Fig. 6*, round on the sheeve A, is hooked into the other eye of the slider at D. By this means, the two horses are so connected that, whenever the one relaxes, he suffers a close and severe pressure of the collar upon his shoulders from the exertion of the other horse, and must either be painfully pulled backward or renew his own exertion; and thus the simultaneous efforts of the two horses, instead of being always unsteady and often conflicting, are so fused into each other as to constitute practically one power; and their combined action, in consequence of their draught being in line, is peculiarly suited to fields and soft roads, where the wheels are liable to sink or be obstructed.

The dormant-bodied cart is suited for carrying substances, such as bags of grain, sacks of flour, hampers, boxes, and the miscellaneous packages of mercantile transit, which require to be discharged by lifting; and it admits of a greater variety of size and construction than even the tilt-cart, yet, in general, bears a close resemblance to that vehicle in all features except those which are immediately connected with tilting. Its shafts are prolonged backward to its extremity, and have, at the axle, projections which serve the purpose of bolsters; and they usually measure in entire length about $12\frac{1}{2}$ feet,—the portions for the yoke and for the forepart of the cart being of the same length as those of the tilt-cart. Varieties of this cart without any box, and with large platform, are very commonly used by public carriers and in large commercial towns.

The French cart has a considerable resemblance to the frameless dormant-bodied machine; but is much simpler and far less scientific in its structure, and might not inaptly be compared to the rude slide-car, mounted on vertically moving wheels. Its poles or shafts are similar to those of the slide-car, but stronger, and are equibrously poised upon the axle; and its wheels are narrow at the tire, very slightly dished, run almost vertically on the road, and are often six feet in diameter. A cart of this kind may be called emphatically the long cart, and admits of being drawn by so many as five or six horses, and, on level roads, may be advantageously used

for the conveyance of very great loads, but, on hilly or uneven ground, incur enormous trouble, and not a little danger, from great and sudden changes of the centre of gravity. "It is obvious," remarks Martin Doyle, "that the attainment of great wheel-power is principally regarded in the construction of the French cart. On ascending and level ground, this mechanical advantage is most desirable; but in descents, it is a serious inconvenience, and, though much counteracted in the larger carts by the application of a friction-break, and also by the removal of all the horses except the shaft one to the rear, in order to hold back on severe descents, by means of tight breeching, the difficulty to that poor brute is great, and the consequence is, that a vast number of the cart-horses in France are injured in the hind quarters by the pressure upon those parts. Then there is the opposite extreme of inconvenience to the shaft horse when in ascent; the belly-band squeezes him severely, and the tendency of the load behind, now deranged from its equilibrium, to lift him from his legs, not only deprives him of any power of pulling, but distresses him exceedingly; and if any relaxation of draught on the part of the leading horses takes place, he is unable to keep his fore-legs on the ground, while he is tortured by the constriction of his belly-band. So great are these opposite difficulties, to be encountered with in the long cart, that we must give it our unqualified condemnation; the necessity of balancing the load with precision is so great, and the attention of the driver so unintermittently demanded to direct the movements of the team, that we repudiate a system of cartage which, independently of the objections to which it is liable even under the most favourable circumstances, has this obvious one, that the animals employed in drawing large carts are liable, on any occasion, to be cruelly ill-treated and overpowered by the brutality or the negligence of ignorant or intoxicated carterers."

The Hampshire cart holds 40 bushels, and is usually laden with 16 cwt. when drawn by one horse, and with 30 cwt. when drawn by two. Its length, irrespective of the yoke portion of the shafts, is $11\frac{1}{2}$ feet; its depth, inclusive of a projection of boarded raves, is $2\frac{1}{2}$ feet; and the diameter of its wheels is 4 feet 4 inches.—The Norfolk carts are constructed on the principle of the dormant-bodied carts, and yet are worked somewhat in the manner, though very awkwardly and cruelly, of tilt-carts. "In setting on manure, a long belly-band is made use of; so that the shafts rise with the forepart of the cart; the shaft-horse being the only stay to its tilting up entirely. Nor is this an uncommon circumstance; the shaft-horse, in this case, remaining upon his hind-legs until he be drawn down again by the fore-horses." [*Marshal's Rural Economy of Norfolk.*]

The London hay-cart is an exceedingly clumsy vehicle; yet it is employed in the carriage of by

far the larger portion of hay, straw, and police-manure in the district round the metropolis, and is therefore very extensively known. It carries 18 cwt. of hay or straw, is provided with tail-piece, fore-ladders, and iron-arms, and can be drawn by one, two, or three horses,—the shaft-horse being yoked under head-rails. It requires great nicety in adjusting the load with a proper reference to the centre of gravity, and would be utterly useless in a hilly district; and it seems to be preferred to a waggon, solely on account of the smaller cost of its construction, and the smaller charge at the turnpikes.—A vehicle with very nearly the body of a waggon, mounted on two wheels, like a cart drawn by two horses, and carrying with ease a load and a half of straw, is advantageously used in some level districts for the cartage of hay.

The tilt-cart, with the addition of a hay-frame, serves as a very good hay-cart, and is used in the harvesting cartage of a large proportion of the farmers of Scotland. In the hay-frame, two main-bearers are fitted to lie across the cart, the one on the fore part close to the front, and the other on the back part close to the door; a pair of light side-rails lie at right angles across each end of the bearers, and are fastened to them with screw-bolts; two rails cross these at right angles behind, and three in front, all the five lying parallel to the bearers; and as the three rails in front project over part of the horse, they are formed with an upward curve, to prevent their interfering with his motions.—But various corn and hay carts, more efficient than the tilt-cart with a hay-frame, are in use; and probably the best of these is Robert Robertson's, represented in *Fig. 10, Plate XII.* which was brought first into trial in 1832, and is described as follows, in the *Transactions of the Highland Society*:—"It is of extreme simplicity in its construction, consisting first of the shafts and usual framing of those intended for the carriage of timber. Upon this is superimposed a wooden frame, extending at once to the breadth of the upper works of the common cart. The outward longitudinal rails of this frame are not continuous, but are cut off before and behind the wheels, and again connected by means of an arched bar of iron. Between these arches, and placed upon the inward rails, there is a board rounded off, to be concentric with the arched bars, and sloping outward, following the dish of the wheels. Across these arches is laid a broad rail, bolted to the former; thus forming a recess for the wheels, and guarding them from rubbing against the load. In front, and immediately behind the horse, a rail is raised, of sufficient height to carry the sheaves above the back of the horse; this rail is supported by two iron stays standing forward on the shafts." This cart possesses much simplicity and ease of construction; it can readily be transmuted into a cart for conveying timber, simply by unbolting the frame from the shafts, and putting in its

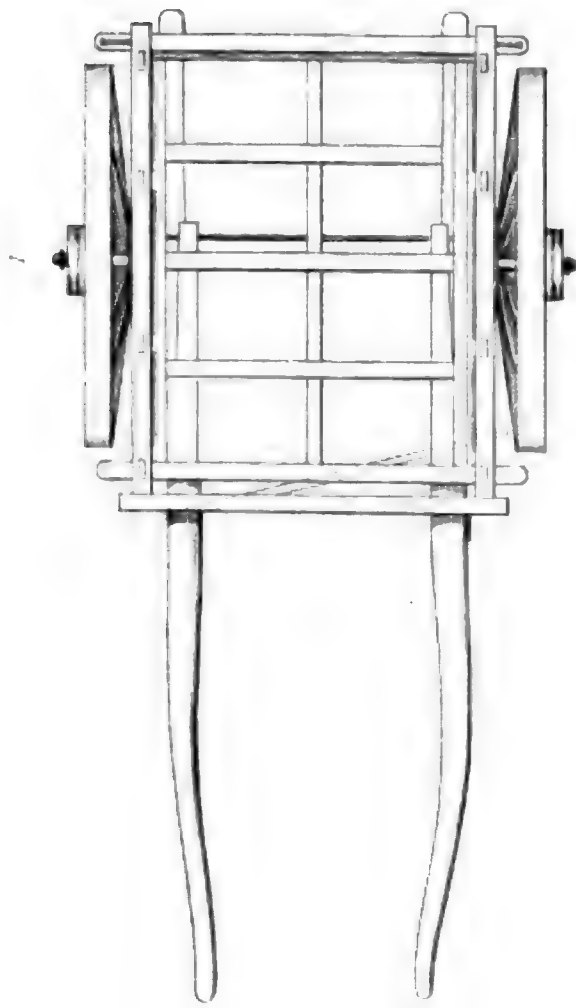


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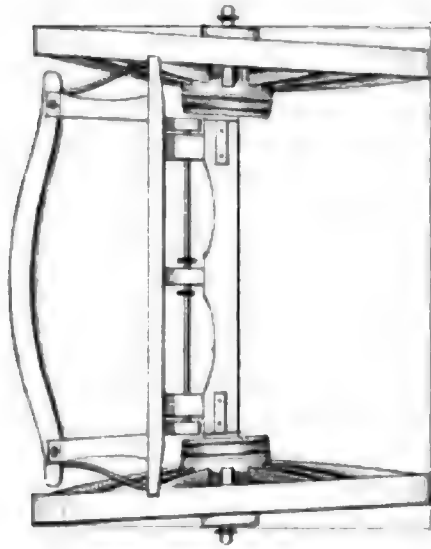
The tail end will be cut off at the
seams as a rule and the tail of the
lower shirt cut off at a lower part
than the tail of the upper shirt. The
upper shirt will be cut off at the
line of the fore part close to the
other end of the back part close to the
end of the fore part close to the
end of the lower shirt and are
screwed to the rail 4 1/2 inches
behind and the other end of the
tail of the lower shirt is cut off
front proper over part of the
lower shirt with the lower shirt
interfering with the lower shirt
and the lower shirt is cut off
with a bayonet and the lower shirt
is cut off at the lower shirt
in the lower shirt and the lower shirt
is cut off at the lower shirt and the
the Tailor's of the lower shirt
is of extreme sharpness and the
side of the shirt and the lower shirt
is cut off at the lower shirt and the

his is up-rimmed with a heavy iron band at once to be bolted with the axle ends, so that the cart can run. The wheels are made of this iron, aren't corrugated, and are 12 ft. long and about the wheels are 12 ft. long by 12 in. of an arched bar at each end, the center of, and placed in the middle, there is a board rounded off, 12 in. long with the rounded ends and weighing 100 lb. forming the rim of the wheel. The arches is held in place by a bolt to the axle, forming a center and the wheels are then in form running on the axle. The cart is made of sufficient to hold the cart above the back of the wheel track, and by 12 in. iron stays standing forward. This cart goes very much simpler than the one described in the first part of the report.

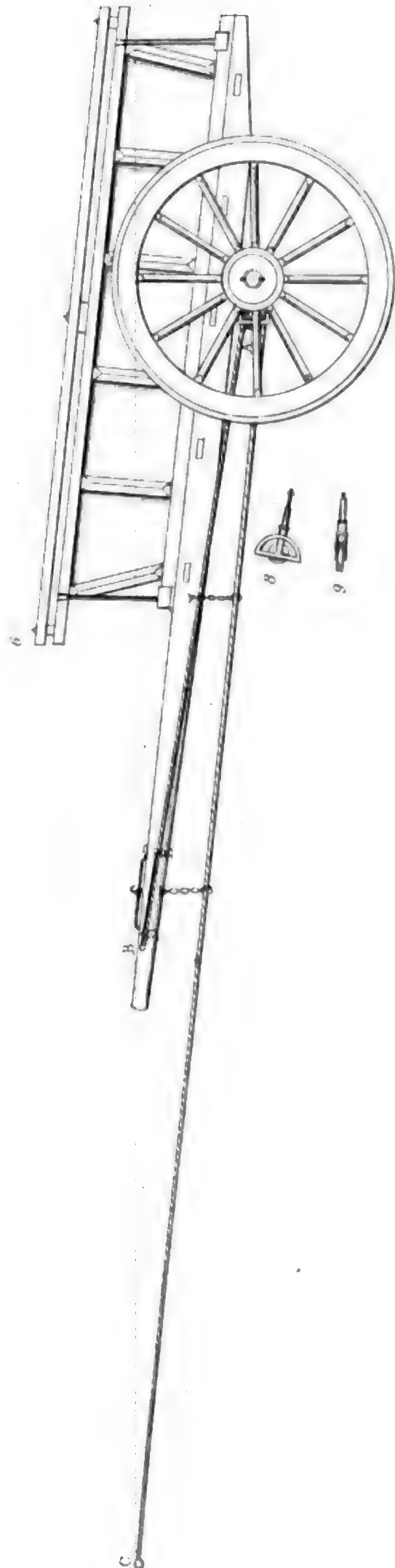
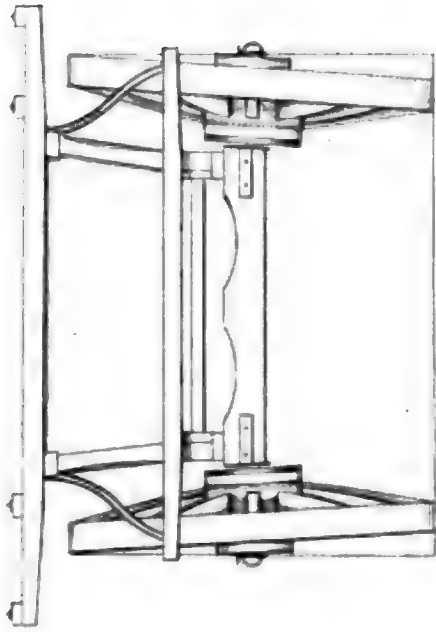
a call for converting time, "the 'L'
 to travel from the dollar and the 'L'



4



7



Scale of Feet



place two single cross-bars, the one before and the other behind the wheels; and, when used for its proper purpose as a hay or corn cart, it permits the full breadth of the load to be laid from the commencement, and, in consequence, facilitates lading, brings the centre of gravity lower than in the tilt-cart with hay-frame, and lessens the risk of upsetting from ruts, stones, or other small inequalities of surface.—The cage-cart for carrying lambs and poultry to market, and some other carts of very peculiar construction, have so restricted a use and so specific a character as not to require description; and carts for carrying water and distributing liquid manure, will be more suitably noticed in articles of their own,—**WATER-CART** and **LIQUID-MANURE-CART**.

CARTAGE. See **CART** and **CARRIER** (COMMON).

CARTHAMUS. A genus of plants, of the thistle division of the composite order. A number of species formerly included in it are now assigned to three other genera; and though about twenty known species are still included in it, only two of these, the dyer's and the sharp-spined, both ornamental annuals, exist in Great Britain. The dyer's species, *Carthamus tinctorius*, also popularly called dyer's safflower and bastard saffron, is a native of Egypt, and was introduced thence to Britain about the middle of the sixteenth century. Its stem is smooth and hard, and branches toward the top; its leaves are ovate, and slightly spinous; its flowers have a vermilion or dark orange colour, and appear in June and July; and its leaves are ovate, whitish brown, and about one-fifth of an inch in length. It is extensively cultivated in the Levant, and in Spain, France, and Southern Germany, and might perhaps be profitably cultivated in the fields of some parts of Britain. It loves a rich soil of medium porosity, and ought, about the beginning of April, to be sown in rows two feet apart, and afterwards thinned out to distances of six inches between plant and plant. Its flowers, which constitute its chief feature of value, are gathered when fully expanded, and are dried on a kiln under pressure, and formed into small round cakes, for sale in the shops; and though themselves of a vermilion or deep orange colour, they dye numerous shades of colour, from yellow to several kinds of red. The flowers are frequently mixed up with the styles and stigmas of the saffron crocus, so as to form a large proportion of the substance sold in the shops under the name of saffron; and they are used also, in Spain and other countries, for colouring dishes and confections. A fixed oil, of inferior value, is obtained from the seeds.

CARTILAGE,—popularly **GRISTLE**. An animal substance, nearly or quite identical in chemical composition with coagulated albumen, but smooth, white, uniform, minutely fibrous, elastic, harder than most other animal substances except bone, and serving to give rigidity or tension to mem-

branous organs, and especially to give elasticity and articulated play to the action of bones. It possesses little vascularity, and small power of vitality, yet undergoes changes consequent upon both healthy and morbid action, and is furnished with a covering membrane called perichondrium; but whether, when partially destroyed, it is reproducible by organic secretion is not known. If fresh bones be digested in muriatic acid till all the earthy salts contained in them be dissolved, a flexible mass, retaining their original figure, and consisting partly of cartilage but chiefly of gelatine, will remain; and if this flexible mass be slowly boiled in water, its gelatine will pass into solution, and its cartilage will be separated as a residuum.

Cartilages, as they exist in the animal frame, are either articular, non-articular, or temporary; and the non-articular are either attached or unattached. Articular cartilages exist, in the form of a layer or tip, at the extremity of every articulated bone, and are thickest at the point of greatest pressure; and they enable the concave end of the one bone and the convex end of the other to slide easily upon one another, and prevent, by their elasticity, all bad effects from frequent abrasion and concussion. The attached non-articular cartilages are situated at the ends of non-articulated bones or between immoveably joined bones, as on the sides of the foot and between the bones of the ribs; and they give to all such bones a flexibility or power of flexile play which they otherwise would not possess. The unattached non-articular cartilages give tension and rigidity to parts, such as the ears and the larynx, which are unsustained by interior bone. Temporary cartilages are succedanea for portions of bones in young animals, and they possess comparatively great vascularity and absorbability, and in consequence are easily ossified, or readily make way by absorption for the secretive deposition of the matter of bones. The cartilages of all parts of the horse, and particularly of his feet, are more liable to ossification than those of any other animal whose cartilaginous history is known; and they always become more or less ossified as horses advance in age, so as to occasion the stiffness of limb and great difficulty of movement by which all old horses are painfully and very observably distinguished. Ossification of the cartilages of the horse's foot may occur at any period, as a consequence of inflammation from bruises or other injuries; and when it takes place, it invariably constitutes what is technically called an "unsoundness."

CART-LODGE. A small out-house for sheltering carts from the weather. Carts kept under proper shelter when not in use, last far longer than if allowed to stand exposed in the yard. See the article **IMPLEMENTS**.

CARUM. See **CARAWAY**.

CARUNCLE. The fleshy tubercular substance at the inner corner of the eye. It directs the

tears into the canal which conveys them to the nostril; but it is sometimes so enlarged by inflammatory action as not to allow them to pass; and it should then be treated with the application of warm, emollient lotions to the eye. See the article EYE.

CARYA. A genus of hardy, deciduous, nut-bearing timber-trees, of the walnut-tree tribe. Several of the species longest and best known were formerly regarded as varieties of one species of walnut-trees, under the popular name of hickery-trees; but they are now regarded as so many distinct species, and were erected into a separate genus by the American botanist Nuttall. About 14 known species, all natives of North America, are now comprised in the genus; and most of these have been introduced to Great Britain. While the filaments of the female flower of a walnut-tree are never fewer than seven, and often more than seven, those of the female flower of a carya are never more than six, and in some instances only four.

The white species of carya, *Carya alba*, formerly *Juglans alba*, was introduced to Britain in 1629. It usually grows to the height of about thirty or thirty-five feet; its young shoots are smooth; its leaves are pinnated, and consist of from three to seven pairs of leaflets, with a terminating odd one; its leaflets are serrated, narrowest at the base, and of a pleasant green colour; its flowers are apetalous and inconspicuous, and appear in April and May; and its nuts are small, hard, and of a white colour. The variety of this species called the shagbark, *C. a. squamosa*, though smooth in its young shoots, is covered with a rough scaly bark in its stems and its old branches.—The olive-fruited species or pecca-nut, *Carya olivæformis*—called by Michaux *Juglans olivæformis*, and in the Hortus Kewensis *Juglans angustifolia*—grows to the same height as the white species, and is distinguished principally by the narrowness of its leaves, and the peculiar form and superior delicacy of its nuts. Michaux says that the nuts of this species are the finest flavoured of all the walnut-tribe; and he recommends that shoots of the pecca-nut should, for the purposes of fruiting, be grafted on stocks of the common walnut-tree.—The pig-nut or hog-nut species, *Carya porcina*, was introduced to Britain in 1799. It attains the same height as the preceding species, and is esteemed the best of the genus for its timber.—The other introduced species are the woolly, the small-fruited, the bitter-nut, the jagged, the furrowed, the obcordate, and the compressed-fruited; and all these grow to the height of about thirty feet, and produce good timber.

CARYOCAR. See BUTTER-NUT.

CARYOPHYLLUS. See CLOVE-TREE and CARNATION.

CARYOTA. A genus of tropical, ornamental trees, of the palm tribe. The stinging or torn-leaved species, *Caryota urens*, is the best known,

and was introduced from India to Britain in 1788. It usually attains a height of about twenty feet, and possesses great economical importance in Ceylon and continental India. All the sugar of the Cingalese, whether for their own use or for exportation, is made from the *Caryota urens*, the *Cocus nucifera*, and the *Borassus flabelliformis*; but the greater portion is made from the *Caryota*, and is well known throughout a great part of the east under the name of jaggery, and commonly sold for one-fourth or one-sixth of the price of the cheapest cane-sugar. A very numerous portion of the population of Ceylon are employed either in cultivating the *Caryota urens*, or in manufacturing jaggery from it; and they constitute a separate caste, under the name of Jaggeraros.—The pith of the *Caryota* is used, in the same manner as the *Sagus rumphii*, the *Corypha umbraculifera*, and one or two other palms, for the manufacture of sago. The dark-coloured oval seeds are used by the Mahomedans of India as beads. A toddy is prepared from the juice of the tree, and used by the natives of Canara and Malabar.—Two other species of caryota, the mild and the horrid, were introduced to Britain in 1820, the former from China, and the latter from South America.

CASCABILLA,—botanically *Croton Eleuteria*. An evergreen, tropical, medicinal shrub, of the spurge tribe. It grows wild in Jamaica, St. Domingo, and the Bahamas, and was introduced from the first of these to Britain in 1748. It grows only six or eight feet high in our hothouses, but attains a height of twenty feet in the West Indies. It is thickly branched at the top; its branches, when broken, exude a thick balsamic fluid; its leaves are alternate, cordate, lanceolate, and entire; its flowers have a whitish-green colour, and are produced in axillary and terminal racemes; and its capsule is trilocular, and contains one shining seed. Its bark is the medicinal part; and this is imported from the Bahamas in quilled pieces, of about six or eight inches in length, and thickly covered with lichens, which give their surface a snowy-white appearance. This bark has a grateful spicy odour, and a warm, bitter, aromatic taste; and is used, in both human pharmacy and veterinary practice, as a valuable aromatic and tonic.—Another species of the *Croton* genus, *Croton cascarilla*, bears the name of cascarilla, but does not share in its officinal honours; and this species is smaller than the other, and was introduced from South America in 1778.

CASCHROM. A very rude and primitive instrument of tillage, used in many parts of the Hebrides. It is probably the oldest instrument of tillage known in Great Britain; and seems to be the most rudimental form conceivable of a plough. Its name means the crooked foot or crooked spade; and the instrument itself has a medium character between that of a spade and that of a rudimental, one-shafted plough. Its shaft or handle is a bough or branch of a tree,

about six feet in length, somewhat curved or bent, and of sufficient strength to bear the pressure of the whole power of a labourer. Its head, or part for contact with the soil, is so flattened as to act rudely like a mould-board; and is provided, at the heel, with a peg on which the workman presses his foot, in the application of his power,—and, at the point, with a narrow, sharp piece of iron, which serves the purpose of a shock or share, to penetrate the ground. This simple instrument is worked merely with the hand and foot of the labourer, and makes but a pitiful rut in the soil; and though it might be useful for operating among rocks or between large stones, it is monstrously unsuited to the tillage of a free field; and, besides doing the work of tillage in a most miserable fashion, it involves three times the cost per acre of what would be occasioned by the plough. Yet, in spite of both expostulation and example, it preposterously continues to be very generally used in many districts of the Hebrides.

CASEUM, or CASEIN. The basis or proper matter of cheese. Caseum is very generally identified with the curd of skimmed milk, obtained by means of rennet, and completely separated from the whey by washing with water; and in this state, it is white, insipid, and inodorous, insoluble in water, soluble in alkalis, and convertible, by means of alcohol, into a fetid adipocirous substance. But, by some chemists, this curd is believed to hold in combination with caseum some acid or earthy salt or other foreign substance, on which its insolubility in water depends; and pure caseum is contended to be a viscid body resembling gum or mucilage, incoagulable by either heat or air, soluble in either hot or cold water, and obtainable from spontaneous curd, or the curd of naturally souring milk, by artificially separating it from some acetic acid which it holds in combination. Spontaneous curd is washed and digested with water; as much carbonate of potash is added as is sufficient to unite with the acetic acid; and the mixture is resolved into caseum and acetate of potash. "In order to separate the caseum from the accompanying acetate, the solution, after separating the cream which collects on its surface by repose, is mixed with a little sulphuric acid, and the precipitated sulphate of caseum, carefully washed, is dissolved in water by means of the smallest possible quantity of carbonate of potash. If alcohol is then freely employed, the caseum itself is thrown down; but if the solution is mixed with about its own volume of alcohol, a deposit of sulphate of potash with some curd and cream takes place, and the filtered liquor contains caseum in a state of great purity."

Soluble caseum, when thoroughly evaporated, has an appearance very similar to gum arabic, and remains for a long period unchanged, and with perfect retention of its solubility in water. It is so adhesive that it might be em-

ployed as a cement for paper, porcelain, and glass; so nutritive, that it might be made into solution with water, flavoured with sugar and aromatics, and used for food by invalids; and so portable and easily preserved, that it might be stored for distant voyages, and employed, in mixture with water, sugar, and butter, as a substitute for milk. When kept in a moist condition, caseum undergoes a kind of fermentation, similar to that which takes place in moist gluten; but, except for its subjectability to this change, it bears, in its insoluble state, a close resemblance to albumen,—and in its soluble state, a close resemblance to gum. Caseum, according to the analysis of Gay-Lussac and Thenard, consists of 59.781 per cent. of carbon, 7.429 of hydrogen, 11.409 of oxygen, and 21.381 of nitrogen; and when burnt, it yields 6.5 per cent. of its whole weight of a white ash, the greater part of which is phosphate of lime. The pungency of old cheese is ascribed by some chemists to a yellow pungent oil, but by most to a peculiar proximate principle called caseic acid.

CASHEW-NUT-TREE,—botanically *Anacardium*. An evergreen, tropical, fruit-tree, of the turpentine-tree tribe. It forms a genus of itself, and takes for its specific name *occidentale*. It grows wild in both the West Indies and the East Indies, and has been known in Britain since the close of the seventeenth century. In its native regions, it usually attains a height of about twenty feet; but in Britain, though easily raised from any of its annually imported nuts, it rarely attains a height of three feet, and is exceedingly difficult to be brought to flower. Its nut or kernel grows on the apex or exterior of its fruit; and, by this singular habit, gives occasion to the name *anacardium*, which signifies "without a heart." The fruit is as large as an orange, and is full of an acidulous juice, which the Americans often mix with their punch. The nut is much broader at the end next the fruit than at the other end; but is otherwise of the shape and size of a hare's kidney. A thick, black, inflammable, and very caustic oil intervenes between the outer shell and the skin of the kernel; and this blisters the mouth of any person, who incautiously attempts to crack the shell with his teeth. The eastern specimens of the tree slightly differ from the western, and are regarded as constituting a distinct variety, under the designation *A. o. indicum*. The milky juice of this variety stains linen a deep and indelible black colour; and the juice of its succulent fruit is used as a remedy for diarrhoea and diabetes. A closely allied species, called by Lamarck *Anacardium longifolium*, and by Sprengel *Anacardium cassuvium*, constitutes a separate genus under the name of *Semicarpus*,—taking for its specific name *anacardium*, and deriving its generic name of *semicarpus* or "fruit-marker," from the marking use which is made of the juice of its fruit.

CASHMERE GOAT. A nobler species of the

common goats, descended from the goat of Thibet, which pastures on the Himalaya. The climate in Thibet is subject to sudden changes. There is little rain, but much snow, as the cold in winter is below the freezing point. Thibet is situated at the northern descent of the Himalaya mountains, and Cashmere at the southern; hence the latter is a little warmer than Thibet. In Thibet, this goat is a domestic animal. It is not allowed a very luxuriant pasture. The favourite food of these animals is buds, aromatic plants, rue, and heath. The people of Thibet give their goats, at least once a-week, some salt, which has always proved a useful accompaniment to the customary food of these animals. If they are transferred from their cold, mountainous abode into a warmer country, the natural consequence follows, that the wool becomes inferior in quantity and fineness. It grows, also, very slowly in the warm part of the year, and more vigorously as the cold season approaches. The head of the Asiatic goat is large, the horns situated backwards, and somewhat curved, the legs slender. The colder the region where the animal pastures, the heavier is its fleece. Proper food and careful tending increase the fineness of the wool. Yearlings, as in the case with the Merino sheep, afford the finest wool. A full-grown goat yields not more than eight ounces. The goats which pasture in the highest vales of Thibet have a bright ochre colour. In lower grounds, the colour becomes of a yellowish-white, and, still farther downwards, entirely white. The highest mountains of the Himalaya, inhabitable by man, contain also a kind of goats with black wool, which, in India, and in the mountainous country of the goats, obtains the highest price, as a material for shawls. The goats of Thibet and Cashmere have the fine curled wool close to the skin, just as the under-hair of our common goat lies below the coarse upper-hair. The wool is shorn in the spring, shortly before the warm season—the time when the animal, in its natural state, seeks thorns and hedges in order to free itself from the burden of its warm covering. All the hard and long hairs are picked out most carefully. The wool, thus purified, is washed, first in a warm solution of potash, and afterwards in cold water, in which process felting must be carefully avoided. It is then bleached upon the grass, and carded for spinning. The shawl-wool is three times dyed—before carding, after spinning, and in the shawl. The Asiatics avoid spinning the wool hard, in order that the shawl may be soft. They use a spindle, which consists of a ball of clay, with an iron wire attached. The finger and the thumb of the spinner are kept smooth by steatite powder. A large shawl, of the finest quality, requires five pounds of the wool; one of inferior quality, from three to four pounds. Main, in London, has invented a machine, which spins this wool, in a very simple way, finer than can be done by the best spindles of Thibet, and, at

the same time, of a firmer thread. The flesh of the Cashmere goat tastes as well as that of the common one; and its milk is as rich, if it is well tended. Since 1820, this species has been introduced into France, and succeeds very well. The enterprising baron Ternaux ordered 1,289 of these goats to be brought to France in 1820, under the care of the celebrated professor of Oriental languages in Paris, Amadée Joubert. Joubert found these goats already spread from Cashmere to the Ural, over Bucharia, in Independent Tartary, purchased them in the deserts there, and transported them over the Volga, along the coast to Theodosia, in the Crimea, where they were put on board vessels to be carried to France. On the voyage, which lasted a long time, a great number died: there remained, however, more than 400 healthy animals, which were sent from Toulon and Marseilles, partly to the Pyrenees of Roussillon, partly to the lime-hills of Provence, and to the pastures of Alsatia and Rambouillet.

CASINGS. Dried cow's dung used for fuel.

CASSAVA. Two species of evergreen, tropical, cultivated shrubs, of the *Janipha* genus and spurge tribe. The bitter cassava, or best known and most extensively cultivated species, is now called *Janipha manihot*, and was formerly called *Jatropha manihot*. It is a native of Brazil, and was introduced thence to Britain in 1739. Its root is woody, and branches into numerous spindle-shaped, farinaceous tubers, about fourteen inches in length and four or five inches in maximum thickness, and very similar in appearance to parsnips; its stem is woody, knotted, and about four feet high; its leaves are smooth and palmated, and increase in breadth to within an inch and a half of the top, when they diminish to an acute point; and its flowers have a brown colour, and appear in July and August. The juice of the tubers is an exceedingly virulent poison; it is often used in South America for envenoming arrows and for purposes of assassination; and it operates with such virulence as to destroy life in the course of five or six minutes; yet it operates wholly on the nervous system, and acquires all its poisonousness from the presence of a peculiar volatile oil, and can easily be rendered innocuous by the application of as much heat as will expel its volatile oil; and hence, it is used as a chief seasoning of a very favourite soup, which the Brazilians call cassarepo. The tubers, even in spite of the natural poisonousness of their juice, yield the well known tapioca of commerce, and afford a highly nutritious food to many thousands of the population of South America, and produce about six times as much farina from any given extent of ground than is usually produced in Britain by wheat.

In a warm climate, upon dry rich soil, the bitter cassava plant is hardy in habit and very easy of culture. After clearing away the shrubs of a previous and exhausted plantation, cuttings or pieces of shoots are planted; in the course of

eighteen or twenty months, the roots of these attain their full size; and while the plants are growing, sedulous care is practised to prevent their upward growth, by breaking out their buds. Each plantation usually yields three crops, and is then abandoned. The natives, in many instances, eat the whole tubers, with no other preparation than roasting in hot ashes; but, more generally, they first manufacture them into flour, and then bake this into cakes; and, too often, they ferment their juice, with molasses, into an intoxicating drink. Cassava bread, though usually not well relished for a time by foreigners, is preferred by the natives and by crooles to all other bread; and it is exceedingly nourishing, and melts to a jelly in a liquid. The tapioca of commerce is manufactured from the tubers in a manner which converts a considerable portion of their starch into amidine; and it is chemically identical with pure potato-starch, modified in a certain manner and to a certain extent with heat.

The sweet cassava, *Janipha laxiflora*, formerly *Jatropha janipha*, was introduced to Britain from Carthage in 1820. It in all respects very closely resembles the bitter cassava in appearance; and is principally distinguishable by the absence of poisonous volatile oil. Even its tubers have no perceptible organic difference, except a tough ligneous fibre which runs through their heart; and they are used for precisely the same alimentary purposes as those of the bitter cassava; yet, in spite of their innocuousness, are far less extensively in favour. Might not both of the cassavas be so cultivated in British possessions, within and near the tropics, as to afford to our home market a large and chief supply of as delicate a farina as that of prime arrow-root?

CASSIA. An extensive genus of yellow-flowering plants, principally tropical shrubs, of the *cæsalpinia* division of the leguminous order. Upwards of two hundred species are known to botanists; and more than one half of these have been introduced to Great Britain. About twenty of the introduced species are annuals, four are biennials, two are perennial herbs, and nearly all the others are evergreen shrubs. Seven or eight are medicinal; and the greater number are ornamental. But additional to these are five or six species, mostly medicinal evergreen trees, which formerly belonged to the genus *cassia*, but are now included in the genus *cathartocarpus*.

Three species of cassia, *C. obovata*, *C. lanceolata*, and *C. italica*, produce the well-known cathartic senna leaves of the drug shops. See the article SENNA.—The fistula species, *C. fistula*, now called *Cathartocarpus fistula*, is an evergreen tree of Egypt, Hindostan, and the West Indies. Its stem is thick, about forty or fifty feet high, covered with a soft cineritious bark, and much branched at the top; its leaves are pinnated, and consist of six pairs of ovate, undulated, pointed, peduncled leaflets; its flowers have a golden colour, and are

produced in long pendent, terminal spikes, and appear in June; its pods are dark-brown, woody, cylindrical, almost an inch thick, and nearly two feet long; and its seeds are smooth, shining, yellowish, and oval, and lie imbedded in a soft black pulp. The pulp around the seeds is medicinal, and has long been known in British pharmacy as the chief ingredient in the electuary or confection of senna. It is viscid, and has a sweet mucilaginous taste, and a somewhat sickening odour; and was supposed by Vauquelin to contain sugar, gelatin, gluten, mucus, resin, extractive, and colouring matter. Its chief use is as a gentle laxative to children.

The winged species, *C. alata*, is a native of both the West and the East Indies, and was introduced from the former to Britain in 1731. It has an ornamental appearance, and usually attains a height of twelve or fourteen feet. Its broad leaves, gathered fresh, bruised, and rubbed upon the part affected, are regarded in India as a cure for ringworm; and the juice of the leaves, mixed with lime juice, is believed to be still more efficacious.—The eared species, *C. auriculata*, is a common jungle shrub of India, and was first brought to Britain in 1777. It carries very beautiful yellow flowers, and is usually about four feet high. Its small, flat, heart-shaped, pleasant-tasted seeds are used, in the medical practice of India, as refrigerants and attenuants; and when reduced to fine powder, are blown into the eyes as a cure for ophthalmia. Both the bark of the stem and the whole substance of the small unpeeled branches, are used for tanning leather, particularly out of neat skins.—The sophora species, *C. sophora*, was introduced to Britain from India so early as about the middle of the 17th century. It usually grows about four feet high, and blooms from July till September. Its leaves are nearly three inches long; and the juice of these and of the root, when mixed with lime juice, is medicinally used in India for the same purposes as the juice of the winged species.—The Tora species, *C. tora*, is an ugly annual of India, growing a yard high, and flowering in August. Its leaves are mucilaginous, pleasant-tasted, and gently aperient; and are used in India as a remedy for the feverishness which accompanies dentition in children. Its seeds are liver-coloured and slightly compressed; and are used in preparing a blue dye, which is usually fixed with lime water.—The Tarantan species, *C. tarantan*, an evergreen undershrub of twenty inches in height, introduced from Cumana,—Richard's species, *C. Richardiana*, an evergreen undershrub of the same height as the preceding, introduced also from Cumana,—the ciliated species, *C. ciliata*, an evergreen undershrub of a foot in height, introduced from Cuba,—the humble species, *C. humilis*, a biennial of a foot in height, introduced from South America,—the ciliated-leaved species, *C. ciliaris*, a biennial of a foot in height, introduced from India,—and the five-angled species, *C. pentagona*, a Lien-

nial of a foot in height, introduced from Peru,—all possess an acknowledged and well-known character as medicinal plants.

CASSIA,—botanically *Cinnamomum Cassia*. An evergreen, tropical tree, of the laurel tribe. It has, on the one hand, been very often ranked as a true laurel; and, on the other, has sometimes been regarded as a mere variety of the cinnamon-tree; but now it is generally regarded as a distinct species of the cinnamon genus. It is a native of Ceylon, Malabar, Sumatra, and Java, and was introduced from the first of these countries to Britain in 1763. Its stem rises to the height of about fifty feet, and sends out, almost from the bottom, large, spreading, horizontal branches; its leaves are smooth, green above, pale grey below, elliptical, pointed, entire, narrow, and from four to six inches long; its flowers are small, white, and monopetalous, and are produced in axillary clusters, and appear from May till September; and its fruit is a black, longish-ovate berry, containing a bitterish pulp. The cuticle or outer bark and the hexagonal fleshy receptacle of the seed, are the well-known cassia-bark and cassia-buds of commerce, possessing the same properties as cinnamon bark, but in a less powerful degree. Yet though the cassia-tree is quite a distinct plant from the cinnamon-tree, most or even all of the cassia-bark and cassia-buds of commerce are probably the produce of the latter, either badly harvested or from inferior trees. See the article CINNAMON.

CASSINE. Several groups of shrubs, partly of the honeysuckle family, but chiefly of the staff-tree tribe. The Cassioberry bush, or bastard cassine, *Viburnum cassinoides*, is a native of Virginia, and has long had a place in the shrubberies of Britain. Its stems rise, in groups of three or four, to the height of about ten feet; its branches are numerous, and grow from the lower as well as the upper parts of the stems, so as to produce a thoroughly bush-like appearance; its leaves are opposite, oblong, lanceolate, and serrated, and are so long in falling as to give the shrub a character intermediate between deciduous and evergreen; and its flowers have a white colour, and are produced in bunches from the sides of the branches, and appear in the end of July, and are succeeded by red berries in autumn. This plant, when grown in the open shrubbery, requires a naturally warm and dry soil, and a thoroughly sheltered situation. An infusion of its leaves is exceedingly bitter, and is said to act efficaciously as a tonic. The dried leaves have sometimes been mistaken for those of the Paraguay or South Sea tea.

The Cassine holly, *Ilex Cassine*, is a native of Carolina, and was introduced thence to Britain in 1726. It is an evergreen shrub of ten or twelve feet in height, and is so branched from the ground upward as to have a sort of pyramidal outline; its leaves are alternate, lanceolate, and similar in colour and texture to those of alater-

nus; its flowers are white, and grow in close whorls round the branches, and appear in August; and its berries are bright red, and continue through most of the winter, and combine with the leaves to produce a very ornamental appearance. This plant may, with careful rearing and good management, grow in the open shrubberies of the south and centre of England. Its leaves have gently narcotic properties, yet, in certain doses, operate either as tonics or as emetics; they were long used by the American Indians as a panacea and universal preservative; and they are supposed to be the Paraguay or South Sea tea, which the Jesuits of a former period turned to most lucrative account by exporting in large quantities from the southern parts of South America. Another species of Caroline holly is exceedingly similar to the Cassine holly, but smaller, and has the name of Dahoon.

Seven species of plants of the staff-tree tribe constitute the genus Cassine. All the species are ornamental, white-flowering, evergreen shrubs, and have been introduced to Great Britain; and most are natives of the Cape of Good Hope, and are there popularly known as Hottentot cherries. Maurocenis' species, *Cassine Maurocenia*, was introduced to Britain in 1690; and usually grows here to the height of about five feet. Its stem is woody, strong, and covered with a purplish bark; its branches are numerous and stiff; its leaves are opposite, dark-green, very thick, entire, about two inches long, and nearly two inches broad; its flowers are produced in clusters from the sides of the old branches, and appear in July and August; and the fruit is a dark purple berry, and ripens in winter. The Cape-phillyrea species is only about a foot high; each of two other Cape species is about two feet high; the tall species from Nepal is nearly twenty feet high; and the remaining two species are about the same height as Maurocenis'.

CASSIOBERRY. See **CASSINE**.

CASSYTHA. A small genus of tender parasitic plants, of the laurel tribe. The filiform species, *Cassytha filiformis*, is a curious native of India, growing a yard high, and carrying white flowers from April till August. Its leaves are used by the Brahmins of the Madras presidency for seasoning buttermilk. An ornamental species was recently introduced from New Holland.

CAST. A swarm or flight of bees.

CASTANEA. See **CHESTNUT**.

CAST-IRON. In our article **IRON**, a general account will be given of the first production or reduction, as it is called, of iron from its ore, and of the kind of metal produced, which, owing to its being very hard, viscid, and incapable of flowing freely, is unfit for making castings in iron. The first running of the iron is called *crude* or *forge iron*, because it has not been refined, but is in a proper state for the forge or mill, where it is converted into bar-iron, for which it is well suited as containing very little carbon. Now,

iron for casting, or *foundry iron* as it is called, becomes good and soft in proportion as it receives a higher charge of carbon, consequently, a completely opposite process must be used to obtain this iron and bar-iron; the one having to be charged with carbon, while the other has to be deprived of it. Accordingly, instead of remelting the forge-iron in a furnace where it is exposed to air and heat only, without contact with the fuel, as is done to make bar-iron,—it must be remelted for making foundry iron in close mixture with the fuel, and with as little exposure to air as possible; and it accordingly undergoes this melting, in which it absorbs an additional quantity of carbon, after which it is tapped and cast into foundry pigs. The name of *pig-iron* is very generally applied in all countries to those straight bars, of about four feet in length, in which iron for casting is sold. The iron, when it first runs from the furnace, is received into a round-bottomed trough or gutter made in sand, from one side of which a number of similar troughs are formed at right angles to the first, and three or four inches apart, the whole being truly level, and open to common communication, so that when the first or principal gutter fills with fluid iron, all the others will fill also, and the quantity of iron when so cast and taken up, resembles an immense comb with coarse teeth. These teeth are knocked off close to their junction with the transverse piece, and then become pigs of iron; while the cross piece, which is always larger and more irregular than the others, is called the *sow*. Pig and sow iron are always sold together; but the sow often contains impurities on the furnace, and is not so much esteemed as the pigs.

CASTING. Iron, as well as brass, and other metals which melt at temperatures above ignition, is cast in moulds made of sand. The kind of sand most employed is loam, which possesses a sufficient portion of argillaceous matter to render it moderately cohesive when damp. The mould is formed by burying in the sand a wooden pattern, having exactly the shape of the article to be cast. The sand is most commonly enclosed in flasks, which are square wooden frames, resembling boxes, open at top and bottom. If the pattern be of such form that it can be lifted out of the sand without deranging the form of the mould, it is only necessary to make an impression of the pattern in one flask; and articles of this kind are sometimes cast in the open sand upon the floor of the foundry. But, when the shape is such that the pattern could not be extracted without breaking the mould, two flasks are necessary, having half the mould formed in each. The first flask is filled with sand, by ramming it close, and is smoothed off at the top. The pattern is separated into halves, one-half being imbedded in this flask. A quantity of white sand, or burned sand, is sprinkled over the surface, to prevent the two flasks from cohering. The second flask is then placed upon the top of

the first, having pins to guide it; the other half of the pattern is put in its place, and the flask is filled with sand, which, of course, receives the impression of the remaining half of the pattern on its under side. After one or more holes are made in the top, to permit the metal to be poured in, and the steam and air to escape, the flasks are separated, and the pattern withdrawn. When the flasks are again united, a perfect cavity, or mould, is formed, into which the melted metal is poured. The arrangement of the mould is, of course, varied for different articles. When the form of the article is complex and difficult, as in some hollow vessels, crooked pipes, &c., the pattern is made in three or more pieces, which are put together to form the mould, and afterwards taken apart to extract them. In some other irregular articles, as andirons, one part is cast first, and afterwards inserted in the flask which is to form the other part. The metal for small articles is usually dipped up with iron ladles, coated with clay, and poured into the moulds. In large articles, such as cannon, the mould is formed in a pit dug in the earth near the furnace, and the melted metal is conveyed to it in a continued stream, through a channel communicating with the bottom of the furnace. Cannon-balls are sometimes cast in moulds made of iron, and, to prevent the melted metal from adhering, the inside of the mould is covered with powder of black lead. Rollers for flattening iron are also cast in iron cases. This method is called *chill casting*, and has for its object the hardening of the surface of the metal, by the sudden reduction of temperature, which takes place in consequence of the superior conducting power of the iron mould. These rollers are afterwards turned smooth in a powerful lathe, which has a slow motion, that the cutting tool may not become heated by the friction.

CASTING IN PLASTER. Copies are most frequently taken, both from new models, and from old statues, by casting them in plaster. For this purpose, a mould in plaster is first made from the surface of the statue or figure itself; and this mould is afterwards used to reproduce the figure by casting. Plaster is prepared for use by pulverizing common gypsum, and exposing it to the heat of a fire until its moisture is wholly expelled. While in this dry state, if it be mixed with water, to the consistence of cream or paste, it has the property of hardening in a few minutes, and takes a very sharp impression. The hardness afterwards increases by keeping, till it approaches the character of stone. Moulds are formed in the following manner:—The statue, or figure to be copied, is first oiled, to prevent it from cohering with the gypsum. A quantity of liquid plaster sufficient for the mould is then poured on, immediately after being mixed, and suffered to harden. If the subject be a bass-relief, or any figure which can be withdrawn without injury, the mould may be considered as finished, requiring only to be

surrounded with an edging. But, if it be a statue, it cannot be withdrawn without breaking the mould; and, on this account, it becomes necessary to divide the mould into such a number of pieces as will separate perfectly from the original. These are taken off from the statue, and, when afterwards replaced, or put together without the statue, they constitute a perfect mould. This mould, its parts having been oiled, to prevent adhesion, is made to receive a quantity of plaster, by pouring it in at a small orifice. The mould is then turned in every direction, in order that the plaster may fill every part of the surface; and, when a sufficient quantity is poured in to produce the strength required in the cast, the remainder is often left hollow, for the sake of lightness, and economy of the material. When the cast is dry, it is extricated by separating the pieces of the mould, and finished by removing the seams and blemishes with the proper tools. If the form or position require it, the limbs are cast separately, and afterwards cemented on. Moulds and busts are obtained in a similar manner from living faces, by covering them with new plaster, and removing it in pieces, as soon as it becomes hard. It is necessary that the skin of the face should be oiled; and, during the operation, the eyes are closed, and the person breathes through tubes inserted in the nostrils. Elastic moulds have been formed by pouring upon the figure to be copied a strong solution of glue. This hardens upon cooling, and takes a fine impression. It is then cut into suitable pieces, and removed. The advantage of the elastic mould is, that it separates more easily from irregular surfaces, or those with uneven projections and under-cuttings, from which a common mould could not be removed without violence. For small and delicate impressions in relief, melted sulphur is sometimes used; also a strong solution of isinglass in proof spirit. Plaster casts are varnished by a mixture of soap and white wax in boiling water. A quarter of an ounce of soap is dissolved in a pint of water, and an equal quantity of wax afterwards incorporated. The cast is dipped in this liquid, and, after drying a week, is polished by rubbing with soft linen. The surface produced in this manner approaches to the polish of marble. When plaster casts are to be exposed to the weather, their durability is greatly increased by saturating them with linseed oil, with which wax or rosin may be combined. When intended to resemble bronze, a soap is used, made of linseed oil and soda, coloured by the sulphates of copper and iron. Walls and ceilings are rendered water-proof in the same way.

CASTING A FŒTUS. See ABORTION.

CASTING A HORSE. The forcing of a horse to the ground, in order to subject him to a surgical operation. It is attended with numerous and important risks; and on account of these, it has been wholly discontinued by some practition-

ers, and ought not, in any case, to be practised unless when the restraints of the twitch and the side-line are insufficient. The best means for casting are the patent hobbles of Mr. Bracy Clark, as improved by Mr. Budd; and when these are cautiously and skilfully employed, no danger whatever may be incurred. A capacious space should be selected, and should be thickly littered with straw; the hobbles should be attached in an order beginning with the forefoot of the opposite side to that on which the animal is to be thrown; the legs ought to be drawn as closely together as possible, but with such slowness and caution as not to alarm the animal; the head should be held by a strong snaffle bridle; the hinder part should be superintended by an assistant ready to direct the fall; and then, if all the assistants act in concert, they may, by one quick and dexterous drawing of the rope, so softly capsize the animal as neither to give him the slightest shock, nor afford him power to hurt himself by struggling. The instant he is thrown, the rope must be fastened; and during the whole time of his being down, his head must be held fast. Care must be used, however, that he fall and lie in such a posture as to have perfect freedom of respiration.

CASTOR-OIL. The Palma-christi or castor-oil plant—*Ricinus communis*—is a native both of the East and West Indies, and has a stem from 5 to 15 or 16 feet in height, and large, bluish-green leaves, divided into 7 lobes, serrated and pointed, the foot-stalks long, and inserted into the disk. The flowers are produced in a terminating spike, and the seed-vessels are covered with spines, and contain three flattish, oblong seeds. It is to the seeds of this plant that we are indebted for the drug called castor-oil. It is now often prepared by pressing the seeds in the same way as is practised with oil of almonds. The oil thus obtained is called *cold expressed* or *cold drawn*. But the mode chiefly adopted in the West Indies is first to strip the seeds of their husks or pods, and then to bruise them in mortars. Afterwards they are tied in linen bags, and boiled in water until the oil which they contain rises to the surface. This is carefully skimmed off, strained, to free it from any accidental impurities, and bottled for use. The oil which is obtained by boiling is considered more mild than that procured by pressure, but it sooner becomes rancid. The mildest and finest Jamaica castor-oil is very limpid, nearly colourless, and has scarcely more smell or taste than good olive-oil. Many people, however, have so great an aversion to castor-oil, even in its purest state, that they do not take it without great reluctance. The uses of castor-oil in medicine are well-known. A dose of it to a horse requires to amount to a pint or even a pint and a-half; and, besides being expensive, is of uncertain and sometimes dangerous operation. In most other domestic animals, however, as well as in man, it acts as a mild purgative.

CASTRATION. The gelding of male animals and the spaying of females, so as to deprive both of their power of reproduction. Emasculation, or the castrating of male animals, is a very ancient practice, and approves itself to all civilized nations as a most powerful means of modifying both the temper and the physical constitution. A castrated horse, though deprived of the great strength and the lofty bearing of his natural character, is deprived also of its ungovernableness and furor; and he becomes similar to the mare in mildness and docility, loses his liability to several serious diseases, acquires many and thorough adaptations to the uses of man, and—except for the one purpose of propagating his species—is at least ten times more valuable than if he had not been castrated. “It certainly,” remarks Delabere Blaine, “is very poetical to lament the degradation of this noble animal; but the finest flight of imagery on one’s tomb, after being worried to death by a stallion, would not repay the loss of riding through life on a temperate gelding.” Equally obvious advantages, though of a different kind, result from the castrating of male calves, male lambs, and male swine.

The colt of the common farm-horse is, in most instances, at the fittest time for castrating when in his fourth or fifth month; but other colts may be best castrated at ages ranging from four months to eighteen, according to their breed, their health, and the purposes for which they are destined. Any season of temperate heat, dry weather, and freedom from the attacks of flies is suitable; and this, in general, can be best commanded late in spring or early in autumn. The operation, except in extraordinary circumstances, ought to be performed only by a veterinary surgeon. The old and still most common method is to open both sides of the scrotum, to cut off the testicles, and apply the cautery. Another and brutal method, called twitching, is to make a tight ligature round the bag between the testicles and the belly, and to allow this to remain till, as a consequence of the stoppage of the circulation and the death of the parts, the testicles drop off. A third method is simple excision of the testicles; but this tends to send inflammatory action into the abdomen, and to induce fatal peritonitis. A fourth and new method, likely to come speedily into general practice, is called the operation of torsion: an incision is made into the scrotum; the vas deferens is exposed and divided; the artery is seized, and twisted six or seven times round, with a peculiarly formed pair of forceps; and, when the forceps are withdrawn, the coils continue on the artery, no blood flows, the testicle is removed, and no sloughing or other danger ensues.

The most suitable time for castrating male calves is early in the second month; and a time nearly as suitable may be found at any period thence till the close of the third month. An old mode was simply to make a tight ligature with

whipcord round the scrotum, till the parts mortified and either were cut away or dropped off. The mode now commonly practised, is to start each testicle through an incision of its covering, to tie a ligature round the connecting blood-vessels so as to stop the circulation, and to detach the started testicles by such a division of the cord that the part of it which remains may immediately retract into the scrotum. A barbarous modification of this method is to seize the started testicle, and pull it with sufficient violence to break asunder the connecting cord. “It is certain,” remarks Youatt, “that when a blood-vessel is thus ruptured, it forcibly contracts, and very little bleeding follows; but if the cord breaks high up and retracts into the belly, considerable inflammation has occasionally ensued, and the beast has been lost. This tearing of the cord may be practised on smaller animals, as pigs, or lambs, or rabbits; the vessels are small, and there is but little substance to be torn asunder; but even there the knife, somewhat blunt, will be a more surgical and humane substitute.” The method by torsion is likely to come into as speedy and general use with calves as with colts.

The most suitable time for castrating male lambs is as soon as the testicles can be laid hold of, or from the tenth till the fourteenth day. No one week or day of the season should be set apart for the purpose; but on every third or second or even successive day, as many lambs should be operated upon as are of the proper age. The usual method of the operation has been already hinted, and does not need to be explained. A nasty practice of many shepherds—one which even Hogg recommends—is to separate the cord with the teeth; and this, besides being both abominable and cruel, may be easily superseded by the use of a blunt knife. In some years, an almost unaccountable mortality follows the castrating of lambs; and the following precautions are suggested by Hogg, as the result of his extensive observation and experience:—“Care should be taken that it be performed at a time when the air is free of electrical fire. Heating of them, too, is often very fatal; and the operator must, by all means, abstain from spirituous liquors. When the lambs are very fat and strong, some farmers anoint the two vacuities in the scrotum with oil of turpentine; one standing with a vial, and anoints with a feather every lamb before it is set away. This is a severe remedy, but it is a sure one, as it repels the effects of the electrical matter on the inflamed parts. It, however, stops the growth of the lambs for a fortnight; therefore, if the folds are clean around, the weather not sultry, and the lambs gently used, there is no great risk without it.”—*Blaine’s Veterinary Art.*—*Youatt on the Horse.*—*Clater’s Cattle Doctor.*—*Youatt on Cattle.*—*Mackenzie on Sheep.*—*Hogg on Sheep.*

CASUARINA. A genus of small, ornamental, evergreen trees, of the amentaceous order. It

takes its name from the supposed resemblance of the branches of its trees to the feathers of the cassowary. Nearly a dozen species were introduced to Britain during the 50 years preceding 1825; one of these, the muricated, was brought from India, and all the others from Australia and Polynesia; three, the glaucous, the knot-flowered, and the equisetum-leaved, produce the male and the female flowers on the same plant, and the others produce them on different plants; two, the four-valved and the most slender, attain heights of respectively about twenty and about twelve feet, and all the others usually grow to the height of about sixteen feet.

CAT. A well-known domesticated, carnivorous quadruped, whose attachment appears to be rather to the dwellings than the persons of her protectors; in which respect her conduct is very opposite to that of the dog, whose alliance with man is founded upon disinterested, personal attachment, not to be affected by changes of place or fortune. Her youthful sportiveness, beautiful fur, and gentle demureness of manner in after life, dispose mankind to regard the animal with kindness; but the most persevering attempts to cultivate her good dispositions are followed with such slight success, and met with so much of deceit and ingratitude, as to weary the patience of the most benevolent. The cat is capable of showing considerable fondness for an individual, but never appears to confide fully, even in the warmest demonstrations of kindness. Her treacherous calmness of disposition needs but slight provocation to be changed to vengeful malignity. When hurt, or much alarmed, she is ready to attack her best benefactor with as much fury as a stranger. Being highly sensitive, and fond of ease, the cat evinces little anxiety, except for the continuance of her enjoyment, and is ever prepared to seek more comfortable quarters, whenever the condition of her patrons may render a movement politic. At what period cats became inmates of human habitations, it is scarcely possible, at this period, to determine. Beyond doubt, their usefulness in destroying rats, mice, and other small animals, first introduced them to notice. The first mention we find made of them, in profane history, is by Herodotus, the father of historians, in his account of Egypt. He speaks of them as diminishing the vermin infesting human dwellings; states some of the Egyptian superstitions relative to them, as well as some observations upon their breeding, dispositions, &c. The celebrated naturalist Temminck, in his excellent monography of the genus *felis*, adduces strong reasons for believing that the cat was originally domesticated in Egypt, and that the gloved-cat, *F. maniculata*—the *chat ganté* of Southern Africa—is, in all probability, the original stock of the domestic cat. Its strong resemblance in size, proportions, &c., renders this opinion more acceptable than that which attributes the origin to the common European wild-cat, which is smaller, has

a shorter, thicker tail, and, indeed, would seem rather to be the domestic cat returned to the savage state, than its original stock. The subtlety and circumspection of the common cat are evinced by all its habits and movements; and the observation of this disposition has obtained for it the name it bears in most of the living languages of Europe. In Latin it was called *catus*, from the adjective signifying cunning, wary, subtle, &c. From this name *catus*, we have the English *cat*, the German *katze*, the French *chat*, &c.

The domestic cat belongs to a genus—*felis*—better armed for the destruction of animal life than all other quadrupeds. The short and powerful jaws, moved by vigorous muscles, are supplied with most formidable trenchant teeth; a cunning disposition, combined with nocturnal habits and much patience in pursuit, gives them great advantages over their prey; and their keen lacerating claws, which are always preserved in the most acute state by the peculiar arrangement that keeps them concealed when not in use, enables them to inflict a death-blow on their victims with as much certainty as ease. The cat, in a degree, partakes of all the attributes of her race,—lies in ambush for her prey, and seizes it by a sudden leap,—plays with her captives before putting them to death,—and does not limit her destruction to the mere gratification of appetite. Cold and wet are disagreeable to the cat, and electricity is especially feared by her: advantage may be taken of the latter circumstance to avert the troublesome visits of the animal. After having once received a shock from a Leyden vial, but little apprehension need be entertained of the cat's return to the same place. Of various aromatic substances, as catnep or catmint, &c., puss is remarkably fond; and the odour of valerian appears to throw her into an ecstasy of pleasure. The food of the cat, in a state of domestication, is necessarily very various, but always of flesh or fish, if it can be obtained. A desire to possess herself of the latter article of diet, proves one of the strongest temptations to theft that the cat is exposed to: in fact, it takes a very severe education to make her any better than a thief under any circumstances. The cat is remarkable for the fetor of its eructations, as well as the powerfully offensive and phosphorus-like odour of its urine, &c. But, personally, it is a very cleanly animal, avoiding to step in any sort of filth, and preserving its fur in a very neat condition. Of its habits, when well taken care of and much petted, it cannot be necessary to speak here, as they are universally known. The cat goes with young for sixty-three days, and brings forth from three to six at a litter, which remain blind for nine days.

CATABROSA,—popularly *Whorl grass*, or *Food grass*. A small genus of aquatic grasses, of the glyceria tribe. Only two species are known, the aquatic and the greenish; and they take their name of catabrosa, signifying "food," from the

keen relish which cattle and water-fowl show for their foliage. Their root is fibrous and perennial; their culm, in its lower part, is decumbent and strikes root at the joints,—in its middle part, is oblique,—and in its upper part is erect; the young leaves and the portions of the culm which are covered by the sheaths of the leaves, are very tender, and have a sweet liquorice-like taste; the leaves are broad and long, and terminate abruptly at the point; the panicle is upright, and has horizontal, whorled, spreading branches; and the glumes are unequal, membranaceous, and broadly ovate, and contain two beardless florets, of much greater length than themselves.—The aquatic species, *Catabrosa aquatica*, grows naturally in Britain, in such rivulets, marshy ponds, and other situations as are usually inhabited by the floating glyceria. It is called by Sowerby and Smith, and by older botanists, *Aira aquatica*, and has already been partly noticed in our article AIRA. It closely resembles the floating glyceria in general habit; but differs in the stiff branching form of its panicle, and in containing only two florets in its spikelets, while glyceria contains from five to eleven. This sweet and delicious grass thrives well on some of the irrigated meadows in the vicinity of Edinburgh; and might be very advantageously made part of the herbage of all irrigated meadows.—The greenish species, *Catabrosa viridula*, grows to only two-thirds of the height of the aquatic species, and usually flowers about a month later.

CATALEPSY. A spasmodic disease, by some regarded as a species of tetanus. It affects the whole body, so as to render it immoveable, as if dead. Tetanus differs from catalepsy in its subjects and causes. Females are most liable to the last, while the first is equally produced in both sexes by appropriate causes. Tetanus is most frequently produced by punctured wounds of tendinous textures, and most readily in hot weather. Sometimes, however, it occurs, like catalepsy, independently of wounds. The spasm is more limited in tetanus; sometimes being most severe in the muscles of the face, producing lock-jaw; now it attacks the muscles of the trunk, on the fore part, and now the muscles of the back part, producing curvature of the trunk backwards. During all this, the natural temperature may remain, the pulse be perfectly natural, and the senses unimpaired. Under the most active and varied treatment, tetanus has always been a very fatal malady.—Catalepsy is a universal spasmodic disease of the organs of locomotion. The body remains in the position in which it may have been when attacked with the fit, and the limbs preserve any situation in which they may be placed. The senses are obliterated, and the mind totally inactive, nothing being able to rouse the patient. The pulse and temperature remain natural. The fit is of uncertain length; according to some writers, not lasting more than a quarter of an hour, though known by others to

be much longer. This disease is an obstinate one, and is very liable to recur, even when the patient seems in the least respect liable to a recurrence. It is, for the most part, a consequence of some other disease. This may be a local affection; but it more frequently occurs in a generally enfeebled constitution, induced by some grave malady, or one which has been caused by the gradual operation of unobserved morbid causes.

CATALPA. A small genus of magnificent ornamental trees, of the trumpet-flower tribe. The syringa-leaved species, *Catalpa syringifolia*, is a native of Carolina, and was introduced to Britain in 1726. It attains a height of forty feet in America, but seldom more than seven or eight in England; yet when raised from seed, and not from layers, it can rise to nearly its natural height on our lawns; and as it has an upright stem and very superb foliage, it might figure as a magnificent standard in many a sheltered opening. Next to the magnolia grandiflora, it is the most gorgeously flowering tree which has ever been introduced to the shrubberies or pleasure grounds of Britain; and it will grow in almost any soil, and produce a gate post which will last through two or three lifetimes. Its timber is a deep yellow, and probably as durable as that of the locust-tree; its bark is smooth and brown; its leaves are cordate, about half a foot long, nearly half a foot broad, and of a bluish cast of colour, and they stand by threes at the joints, and are not produced till late in spring; and its flowers are tubulous, and have a white colour, with purple spots and yellowish stripes on the inside, and are in bloom from June till the latter part of August.—Two other species, *C. longissima* and *C. microphylla*, have been introduced to Britain; but both are tropical plants and evergreens.

CATANANCHE. A small genus of hardy, ornamental, herbaceous plants, of the succory division of the composite family. The azure species, *C. cœrulea*, was brought to Britain from the south of Europe, toward the close of the 16th century. Its root is perennial; its flower-stems grow in groups of from three to ten, according to the size and strength of the root, and rise to the height of about a yard, and ramify into small branches adorned with minor leaves; its principal leaves lie flat on the ground, turning their points upwards, and are numerous, narrow, hairy, and jagged; and its flowers have a fine blue colour, and a beautiful appearance, and are produced in single heads at the top of the stems, and appear from July till October. This plant is a powerful incentive, and was formerly used in philtres.—The yellow-flowering species, *Catananche lutea*, is an annual of about ten inches in height; and was introduced from Candia about the middle of the 17th century.

CATAPHAGUS. See WIRE-WORM.

CATAPLASM. Any kind of poultice intended to be applied to the surface of the body. Cata-

plasmas are commonly made of meals, powders, boiled pulps, &c., mixed with water, milk, or some other liquid. They are called *sinapisms* when mustard forms their base.

CATAPPAN,—botanically *Terminalia Catappa*. An ornamental, fructiferous, evergreen, tropical timber tree, of the combretum tribe. It is a native of India, and was introduced to Britain in 1778. It is one of the most beautiful trees in the world; and, at the same time, possesses considerable economical value. Its stem usually attains a height of about twenty feet; its leaves grow in bunches at the end of the branches; its flowers have a whitish green colour; and its fruit resembles the almond in both appearance and taste, but has a flavour similar to that of the English filbert. The kernels of the fruit yield a fixed oil, and are eaten in India, not only as a dessert, but as a light and nourishing diet; and the timber is esteemed a valuable kind of native wood, and generally used in making pikoties.—A large subdivision of the terminalia genus, including the medicinal benzoin tree, take the Catappan for their type, and are distinguished from the rest of the genus by having their fruit compressed or much attenuated at the margin.

CATARACT. A disease in the eye of man or of the lower animals. Its principal feature is the opacity of the crystalline lens, and the consequent obscuration or total loss of vision. But in the horse, the other internal parts of the eye, also, are much deranged; and the iris, in particular, adheres sometimes to the lens and sometimes to the cornea, and, in some cases, so contracts its pupillary opening as to render the cataract scarcely perceptible. Cataract in the horse is never an independent disease, but occurs in consequence of the inflammatory action of ophthalmia; and, when fully formed, is incurable. The operation of couching or extracting, which acts beneficially in some other animals, is in a great measure rendered nugatory in the horse by the complication of the disease over other parts than the lens; and even when partially successful, it cannot enable the animal to discern minute objects, or prevent him from always being very timid and easily started. Cataract in one eye of an ox is not of very rare occurrence, and does not prevent him from fulfilling the ends of his being; and cataract in both eyes is much less frequent than in the horse, and renders it expedient to devote him immediately to the shambles.

CATARRH. Copious and diseased secretion of mucus from the nose, mouth, throat, and bronchiæ of animals. It is exceedingly various in extent and character, but is accompanied always with more or less of inflammatory action, and frequently with more or less of febrile excitement; and it comprises most or all of the diseases which are popularly designated colds. Its varieties arise, not only from degrees and modifications of inflammatory and febrile action, but from the extent of surface inflamed, the particular organs

or parts of organs affected, the mutual connexions of the affected organs, the simultaneousness or successiveness of attack in different parts, and sometimes the special character of the exciting cause and the complication of action from accompanying distemper in the stomach, bowels, or general constitution. When it arises from epidemic or epizootic causes, or prolongs and exasperates itself into violent fever, it generally takes the name of influenza, and requires different treatment from what is proper in its ordinary forms. See the article **INFLUENZA**. A general but slight affection of the extensive mucous surface of the nose, mouth, and throat, constitutes a common cold, or catarrh in the most general sense; and an affection of a more aggravated kind, or one which sinks deeper into the air passages, so as to produce sensations of strangulation or dyspnoea, becomes, in popular language, strangles, sore-throat and inflamed breast, or, in technical language, angina parotidea, angina pharyngo-laryngea, and angina trachealis vel bronchealis. We shall, in the present article, speak only of catarrh in the most general sense, or of what is popularly called a common cold.

The causes of catarrh in the horse are very numerous, and often exceedingly slight and trivial. If the system happen to be in a reposing or morbidly disposed condition, catarrh is excited by the most trifling causes; and even when the system is energetic and in the exercise of full self-defence, the disease may be occasioned by exposure to rain or unusual cold, by change of stable, clothing, or weather, by neglect of grooming, by sudden cooling after labour, by exposure to any great or sudden transitions of temperature, or by the prevalence of sharp east winds during the moulting of spring. An attack is first indicated by a thin watery secretion from the nose, and sometimes also from the eyes. The lymphatic glands are irritated by the flow of the acrid secretion, and become tumefied and tender; symptomatic fever follows the inflammatory action; cough, in many instances, is excited; coagulable lymph, and afterwards yellow muco-purulent matter, flow from the nose; and, in the course of a few days, the several symptoms either vanish or become aggravated into other and worse forms of disease. A mere catarrh, viewed in itself, is very seldom an affair of any consequence; but, if neglected, and especially if maltreated, it often induces the most serious and even incurable diseases of the chest and lungs.

“On the first attack of this complaint,” says Mr. White, “bleeding will generally be found an effectual remedy; but if it is neglected until a considerable discharge has taken place from the nostrils, it seldom proves beneficial. A dose of fever powder is to be given every morning and evening until the symptoms abate, or a considerable diuretic effect is produced, and then every second or third day only. Sometimes a swelling takes place in the parotid glands, which are situ-

ated immediately behind the ear. Should no unusual heat or tenderness be observed in those swellings, apply the stimulating ointment recommended for strangles; but if they feel hot, are painful, and appear to be in a state of active inflammation, a poultice is the best remedy. If the eyes are inflamed and watery, a rowel should be inserted under the jaw; and if the inflammation in the throat is so considerable, as to render swallowing painful and difficult, a blister will afford great relief. Hot bran mash should be given frequently, which will not only serve to keep the bowels open, but will act as a fomentation to the inflamed membranes, since the horse will be constantly inhaling the vapour which escapes from them. Should he be costive (which is not likely to happen while he is taking bran mash), let glysters be injected occasionally. The head and chest, as well as the body, should be well clothed, the legs frequently hand-rubbed, and a large quantity of litter allowed; by these means, he will soon be restored to health." But this is the proper treatment for only such violent forms of catarrh as verge on other and worse diseases: mere extra care will cure the majority of cases; mere comfortableness of stable and clothing, a few warm mashes, and a fever ball or two, will cure nineteen cases in twenty; yet bleeding ought to be practised whenever there is fever.

Catarrh in cows and oxen is popularly known under the name of hoose. The causes of it, as in the horse, are multifarious and often trivial; and both the symptoms and the consequences of it are precisely similar. Though hoose, especially when accompanied with cough, is often the premonition of serious and incurable diseases, it is very generally treated with brutal ignorance or culpable neglect. A farmer hears some of his cows coughing, perhaps hardly and painfully; but so long as they continue to take a fair quantity of food, he pays no attention to their distemper. Their cough seems to be attended with but little inflammation; it remits and returns; it is aggravated by his exposing them to cold or wet; it becomes hoarse and hard, in consequence of his crowding them into hot and ill-ventilated cow-houses; yet, till it ceases to be a principal symptom, and is followed by loss of appetite and begun emaciation, he does not dream that the brutes are seriously ailing,—and then they are irretrievably and vitally diseased in the respiratory system, and, in spite of all he can do for them, are quite beyond remedy. Yet any cold, if wisely treated in any of its earliest stages, may be cheaply and easily cured. Warm housing, a few mashes, and a cough and fever drink will usually succeed; and the last of these remedies may consist of one drachm of emetic tartar, three drachms of saltpetre, half a drachm of powdered foxglove, and a quart of pretty thick gruel.

Catarrh in sheep has similar symptoms as in horses and cows. In all mild or ordinary cases,

even though it attack a whole flock, and indicate itself by nasal discharge, it is of small consequence, and requires no further treatment than a little shelter. But when it becomes so virulent as to verge on bronchitis, or assume a highly inflammatory character, it demands instant attention. "If there is one sheep that stays behind or will not eat," says Clater, "the shepherd should catch him, and remove him to a warmer situation, and bleed him, and give him the laxative and fever drinks, and nurse him with mashes and hay. If a second or third sheep should fail in the same manner, he must indeed look about him; there is danger to all, for the inflammation has spread itself from the throat down the wind-pipe to the air-passages of the lungs, and a very dangerous disease, called bronchitis, is produced. He must move the whole flock to a more sheltered situation. He must move them to a pasture of somewhat different character. He must take them from their turnips or their hay, and give them whatever food his farm will afford. He should, if he will take the trouble to do so (and he would be amply repaid for that trouble), bleed them all round, and physic them all. This is strange doctrine to the farmer, who is accustomed to look on, and let things take their course. It is, however, good advice, and he will find it so, if he will but follow it. Yet let him not, in his determination to rouse himself to do something, listen too much to the suggestions of the shepherd or the farrier. Let him not give any of those abominable cordial drinks which have destroyed thousands of sheep. Warmth, housing at night, littering with clean straw, and warm gruel, if the animal will not eat or drink, are not only allowable but useful; nay, I would allow a little ginger or a little ale with the medicine; but not those compounds of all manner of hot and injurious spices which would kindle a fire in the veins of the animal, if it were not blazing there before." — *Turton's Medical Glossary*. — *Blaine's Veterinary Art*. — *White's Veterinary*. — *Spooner on Sheep*. — *Youatt on Cattle*. — *Youatt on the Horse*. — *Clater's Cattle Doctor*.

CATCHFLY, — botanically *Silene*. A large genus of plants, of the carnation tribe. Five species grow wild in England, one in Scotland, four in both England and Scotland; about one hundred and fifty have been introduced from foreign countries, chiefly the continent of Europe, and the parts of Asia and Africa nearest Europe; and about seventy other species have been scientifically described. More than one-half are annuals, a few are biennials, and most of the others are perennial-rooted herbs. Many are mere weeds, and a considerable number are fine ornaments of the open border of the flower garden. Their botanical name is formed from a word which signifies 'saliva;' and both this and their popular name of catchfly allude to a frothy viscid moisture which they exude from their stems, and which, in some of the species,

is so sticky as to retain hold of any flies which touch it.

The English species, *Silene anglica*, is an annual weed of hedges, sandy fields, and dry pastures in Britain. Its stem is hairy, and about ten inches high; its leaves are oval and dusky green; and its flowers are white, and appear in June and July.—The stemless species, *S. acaulis*, is a very small, pretty, perennial-rooted herb of the Scottish mountains, growing close to the ground, and carrying one kind of it white flowers, and another kind pink flowers, from June till August.—The inflated species, *S. inflata*, is a curious perennial-rooted shrub of the corn-fields of Britain, growing about fifteen inches high, and carrying white flowers from May till September.—The five-wounded species, *S. quinquevulnera*, is a beautiful annual plant, of the sandy fields of England, about fifteen inches high, and having a blood-coloured bloom.—The conical species, *S. conica*, is an annual, purple-blooming weed, of the same height and habitat as the preceding.—The otites species, *S. otites*, is a curious, perennial-rooted weed of gravelly soils in England, growing twelve or fifteen inches high, and carrying cream-coloured flowers in July and August.—The sea species, *S. maritima*, is an interesting perennial-rooted native of the sea-shores of Britain, about ten inches high, and carrying white flowers in August and September.—The sweet-william species, *S. armeria*, is a beautiful pink-flowering annual, but includes also a white-flowering variety, of the corn-fields of England; and it attains a height of about twenty inches, and has long held a prominent place among the cultivated flowering annuals of the parterre.—The nodding species, *S. nutans*, is an uninteresting, two-feet-high, perennial-rooted herb, of calcareous rocky grounds in England.—The night flowering species, *S. noctiflora*, is a curious, pink-flowering, two-feet-high annual, of the sandy fields of England.—The introduced species most commonly cultivated as ornamental plants in gardens, are, of annuals, muscipula, hortensia, reticulata, clandestina, vespertina, virginica, gallica, ægyptiaca, and puta; of biennials, bupleuroides; and of perennials, stellata, catholica, nodiflora, tartarica, sibirica, parviflora, reflexa, pennsylvanica, regia, fimbriata, polyphylla, vallesia, and chloræfolia.

CATCHWORK. A kind of irrigated meadow, in which one set of channels act both as feeders and as drains, or in which a lower set of feeders catches the water in its descent from a higher set. This is a very imperfect sort of water-meadow; and necessarily has great variety of alignment in its channels, adapted to the peculiar irregularities of the ground on which it is formed. "To give directions for the formation of a catchwork," says Mr. Stephens, "is beyond the ingenuity of man; for no two pieces of land are precisely alike, which renders it impossible for the irrigator to follow the

same plan in one field that he has done in another."

CATECHU. An extract prepared from the wood and the green fruit of the *Mimosa catechu*, and of several other trees of the same family, which grow in the East Indies, principally in Bengal. There are three sorts of catechus. The first, Bombay catechu, is in square pieces, of a reddish-brown colour, friable, of a uniform texture, fracture uneven, of a specific gravity of about 1.39. The second, Bengal catechu, is in round pieces, of the weight of three or four ounces, of a deep chocolate colour internally, and resembling iron rust externally, more friable, of the specific gravity of 1.28. The third kind, catechu in masses, is in irregular pieces of two or three ounces, of a reddish-brown colour, shining, homogeneous, and wrapped up in large-nerved leaves. These three kinds of catechu are inodorous, of an astringent taste at first, but, soon after, sweet and agreeable; at least, this is the case with the first and last sort. Catechu is one of the best astringents to be found in the materia medica, and likewise one of the most in use; and it is extensively employed in veterinary practice as well as in human medicine, but is very generally known among farriers under the absurd name of Japan earth.

CATERPILLAR,—botanically *Scorpiurus*. A genus of very curious, hardy, trailing annuals, of the hedysarum division of the leguminous order. Two species, the smooth-leaved and the acute-leaved, were introduced within the last thirty-three years, the former from the Archipelago, and the latter from Corsica; and both have a pretty appearance, grow six or eight inches high, and carry yellow papilionaceous flowers in June and July. But four other species, the worm-podded, the prickly, the furrowed, and the subvillous, were long ago introduced from the south of Europe, and grow two feet high, and are general favourites in garden culture for the remarkable and very curious appearance of their pods. Their flowers are small, yellow, and papilionaceous, and bloom in June and July; and their pods so greatly resemble caterpillars, that a person ignorant of their nature, and seeing them from a brief distance, would suppose them to be actual caterpillars feeding upon the plants. The worm-podded and the prickly species, *S. vermiculata* and *S. muricata*, are the most interesting.

CATERPILLAR. The larva of a butterfly, a moth, or a saw-fly. The names caterpillar, grub, and maggot, are popularly used in so indefinite and random a manner, that, though evidently designating three divisions of larvæ, they cannot without great difficulty, if at all, be so defined as not to intrude within one another's limits. But if all larvæ be divided into monomorphous and heteromorphous, the former greatly resembling the perfect insects, and the latter totally unlike the perfect insects; if the heteromorphous be divided

into the *ecapitatæ* and *capitatæ*, the former without distinct scaly heads, and the latter with distinct heads; and if the *capitatæ* be divided into *apodæ*, *hexapodæ*, and *hyperhexapodæ*, the first without legs or prolegs, the second with six scaly legs but without prolegs, and the third with six legs and a variable number of membranous prolegs; then the last of these subdivisions, the *hyperhexapodæ*, is identical with caterpillars; and while scientifically exact, it so precisely comprises the larvæ of butterflies, moths, and sawflies, as almost exactly to correspond with the sense in which the word caterpillar is popularly understood.

We must refer to our articles BUTTERFLY, MOTH, and SAW-FLY, for a notice of the chief genera and most mischievous species of caterpillars, as well as for hints respecting the best methods of preventing their devastations; and shall here restrict ourselves to a few cursory entomological remarks respecting the structure and habits of caterpillars.

A caterpillar, on its exclusion from the egg, is of comparatively very small size; but it has a voracious appetite, and it grows rapidly in size. Its cuticle, however, is but slightly if at all extensible, and requires to be cast; the succeeding cuticle is also inextensible, and requires to be cast; and thus cuticle after cuticle is thrown off, in a series of moulting, till the creature attains its full size, and is ready for transmutation into the future form of its existence. While an old cuticle is becoming too tight, a new one is forming beneath; and when the former has fully served its purpose, it gradually rends along the back, till the animal completely shakes it off, and appears with his new coat, and of a larger size. During the progress of the moult, the caterpillar is sluggish and does not eat; but whenever it is completed, he resumes his activity, and displays his former voracity.

Almost all caterpillars have a fleshy body, and an elongated, cylindrical, and serially annular form. The series of conjoined rings constituting the cylinder, amounts to thirteen; and the first of the rings represents the head of the perfect insect, the second, the third, and the fourth represent the thorax, and the remainder represent the abdomen. On each side of the body are nine breathing spiracles. The head, in most instances, is more scaly than any of the other rings; its mouth is furnished with a pair of very strong jaws, two fleshy under-jaws with their two palpi, and an underlip with its two palpi; and the head itself is furnished with two short conical antennæ, and, on each side, with six minute shining tubercles, which appear to be the rudimental eyes of the perfect insect.

Most caterpillars are covered with hairs, some with tubercles or warts, and a few are covered with small spines or bristles. The hairs or spines of all appear to be designed for protection; those of one species are as hard and rigid as wire;

those of many species produce various degrees of irritation, from a slight uneasiness to a pungent stinging like that caused by the nettle; and those of not a few, or perhaps of the larger proportion, enable the insects to protect themselves somewhat in the manner of the hedgehog, or to let themselves fall without injury from considerable heights.

All caterpillars have both legs and prolegs, the former permanent, and the latter temporary. The legs are horny and pointed; they constitute the rudiments of the legs of the butterflies which are destined to evolve from the caterpillars; and they amount to three pairs, and are attached to the three first segments of the body, or destined thorax of the perfect insect. The prolegs are short, soft, and conical; they belong to merely the larva condition of the insects; and they vary in number, in the different species, from two to five pairs. The geometrical caterpillars have two pairs of prolegs, on respectively the last and the ninth segments of their body; and the caterpillars of the common cabbage butterfly, have five pairs, on respectively the sixth, seventh, eighth, ninth, and twelfth segments of their body. The feet of prolegs are circular discs or suckers, each surrounded with a series of minute, slender, horny hooks; and by means of these, the caterpillars either expedite their movements, or take a firm hold of leaves or other objects to which they wish, for a time, to attach their bodies.

Caterpillars spin threads somewhat in the manner of spiders; some, to form mimic cables for protecting or suspending their bodies; some, to construct cells and nests as places of retreat; some, to form tents as places of inhabitation; and some, to form enveloping cocoons around their chrysalis condition, or while they are in process of transformation from caterpillars to butterflies. The spinneret appears in the form of a small tube or protuberance between the labium and the foremost pair of limbs; it consists of alternate portions of horny and membranaceous matter, and terminates in a single orifice shaped somewhat like the end of a writing-pen; two ducts bring up the liquid silk, or material for the thread, from two, long, slender, tortuous sacculi, to this terminating orifice; and these sacculi run down the interior of the sides of the caterpillar, and secrete the silky matter in the form of a cohesive mucilaginous-looking fluid, and they vary in length, capacity, and secretive power, in the different species of caterpillars, according to the quantity of silky matter which the habits of the several species require. Some caterpillars suspend themselves upon twigs or branches, by means of a belt of their own silken threads wound round their body; some, with a similar effect to the spider, though in a different manner, descend and ascend their tiny silken cables at pleasure; some combine in great societies, to weave tents, and others to construct nests or halls or many-celled mansions for their com-

mon inhabitation; some use their silken thread as cordage for rolling up large leaves of plants, and binding them into a sort of natural tents; and some—the most celebrated of which are the silkworm caterpillars—spin one thread of enormous length into an enveloping cocoon for protection of the pupa transmutation. See the articles COCOON and CHRYSALIS.

Most species of caterpillars are vegetable feeders, and inflict more or less injury upon useful vegetation; a few, as the galleriæ, devour lard, wax, and other fatty substances; and some, as the caterpillars of the clothes'-moth, feed upon cloth, furs, and other matters of animal origin. The little green tortrix, which infests the oak, sometimes strips that tree of nearly all its foliage; the common garden caterpillars make great devastation upon the leaves of cabbages, gooseberry-bushes, and other garden plants; and numerous other species live wholly upon foliage, and either damage or destroy vegetables by devouring their leaves. Some species feed upon roots, seeds, buds, and flowers; and a few feed upon the ligneous parts of trees, boring through their stems, and sometimes completely destroying their young shoots. Some restrict themselves to one kind of plant; and others, as the caterpillars of the garden tiger-moth, feed upon many different kinds. Many feed by night; but the greater number feed by day.

CATHARTIN. The active principle, or peculiar chemical principle, of senna. It is saline, uncrystallizable, deliquescent, reddish yellow, bitterly nauseous, and of a peculiar odour. It is soluble in either alcohol or water, but not in ether; and its aqueous solution is precipitated by the infusion of galls or the subacetate of lead. Its medicinal properties are those of a concentrated infusion of senna leaves; and when this infusion is evaporated to dryness and burnt, it yields potash, sulphate of potash, magnesia, silica, and carbonate of lime. See the article SENNA.

CATHARTOCARPUS. A genus of evergreen, medicinal, tropical trees and shrubs, of the cæsalpinia division of the leguminous family. Eight species have been introduced to Great Britain; and five or six other species are known to botanists. The best known species, *C. fistula*, was formerly classed as a cassia, and has been described in our article CASSIA. Three of the other introduced species, Humboldt's, Roxburgh's, and the Brazilian, also were formerly included in the genus cassia; and the first is from the Caraccas, and grows forty feet high,—the second is from India, and grows twenty feet high,—and the third is from South America, and grows thirty feet high. The other introduced species are from Java, Trinidad, Mexico, and Sierra Leone; and the first has usually a height of about twelve feet, and each of the others about twenty feet. The name cathartocarpus means "purging fruit," and alludes to the medicinal properties of the legumes.

CATKIN. An assemblage of small, incomplete, scale-like flowers, arranged upon a rachis, and growing pendulously, so as to have an appearance somewhat like a cat's tail. Familiar examples of it occur in the inflorescence of willows and poplars. The flowers of a catkin are destitute of both calyx and corolla, but they have a scale-like bract which attaches them to the rachis or common elongated receptacle. The catkin is the characteristic of the large division of trees called amentaceous. See the article AMENTACEOUS TREES.

CATMINT,—botanically *Nepeta*. A genus of herbaceous plants, of the lip-flowered family. The common species, *Nepeta cataria*, grows wild on road sides, borders of fields, and moist waste grounds, in Great Britain. Its root is perennial; its stem is square, hoary, and between two and three feet high; its leaves are broad, slightly indented on their edge, deeply whitish on their under surface, and whitish green on their upper surface; and its flowers grow in axillary cymes on different parts of the stem, and are white in colour, and appear from July till September. This plant has a strong and not very agreeable odour; and, on account of its being greatly relished for both taste and odour by cats, it has given the name of catmint to the whole genus. About forty species of catmint have been introduced to Britain from foreign countries, particularly from those between the Levant and Siberia; and, with the exception of one hardy annual, and one tender biennial, all are hardy, perennial-rooted herbs. Nearly twenty of these species are ornamental; and a few of the others are curious; but none possess any noticeable economical value.

CAT'S EAR,—botanically *Hypochaeris*. A genus of hardy herbaceous plants, of the succory division of the composite order. The smooth species, *H. glabra*, is an uninteresting, annual, yellow-flowering, one-foot-high weed of the sandy heaths of Britain. The spotted-leaved and the long-rooted species, *H. maculata* and *H. radiata*, are perennial-rooted, yellow-flowering weeds, the former of the chalky hills of England, and the latter of the meadows and pastures of Great Britain; but both are now assigned to the new genus *achyrophorus*,—a name which signifies "the bearer of chaff." Eight or nine species of cat's ear have been brought to Britain from foreign countries; but they possess little or no interest.

CAT'S TAIL,—botanically *Typha*. A genus of hardy, aquatic, reed-like plants, forming, with the bur-reeds, the natural order typhinae. The plants of this order have strong creeping roots, and long soft or round prickly assemblages of florets resembling catkins; and they abound in ditches and lakes in very many parts of the world. Three species of the genus *typha*, of respectively two, four, and six feet in height, inhabit the ditches, pools, and marshes of Britain, and carry brown flowers in July; and all are used, in the manner of reeds, for various economical purposes.

CAT'S TAIL GRASS. See PHLEUM.

CATTLE. Animals of the domestic ox species. Our articles **BULL**, **Cow**, and **Ox**, give general views of respectively the male, the female, and the castrated male of the domestic ox; our articles **BREEDING** and **CROSSING** discuss the artificial methods of improving the form, size, and habits of cattle; and our articles **FEEDING**, **FATTENING**, **GRASS-LANDS**, **PASTURE**, and **FARM-YARD**, show how they ought to be reared, fed, lodged, and generally treated. In the present article, therefore, we shall merely notice the characteristics and the several breeds of British cattle.

The Different Breeds of Cattle.—The diversities observable in the size, shape, habits and produce of the cattle of Great Britain and Ireland, have arisen partly from modern artificial breeding, but chiefly from the prolonged and combined influence of climate, soil, pasturage, and general treatment. So long as cattle were allowed their natural liberty, unrestrained and unmodified by enclosures, cultivation, and artificial treatment, all were clean-made, glossy, swift-footed, shy, spirited, and active; but when they became completely subject to the control of man, and dependent on him for food and protection, they lost their sagacity and energy; such as were amply supplied with nutritive food became plethoric, bulky, and sluggish; and such as were ill-fed continued small in size, and acquired bad shapes, and lean, feeble, unproductive habits. Comparatively few of them migrate from district to district, or undergo changes of climate, pasturage, and artificial treatment; but most are reared and fed for generations in the same district, and many on the same estate or farm; and they consequently retain for ages an uniformity, or at the utmost a very limited diversity, of size, shape, and constitutional qualities. Hence, particular breeds were formed and fixed long before the modern period of artificial improvement; large, strong breeds pervade some districts, and small, weak breeds pervade others; powerful, bulky, well-formed, and productive breeds are coextensive with the range of climate, soil, herbage, culture, and treatment best fitted to improve them; such large cattle as those of the eastern counties of Scotland are merely varieties of the same breed as the small ones of the Grampian Mountains and the Hebridean Islands; and the smallest, feeblest, worst-shaped, and least productive are capable of being, in the course of two or three generations, transmuted, by means of superior climate, feeding, crossing, and management, into as valuable cattle as any of the best existing varieties.

The breeds and varieties of cattle at present reared on British farms are exceedingly numerous, and approximate one another by a series of the nicest and almost imperceptible gradations. Yet, though capable of multitudinous classification, and though often requiring, for purposes of convenience, to be arranged into numerous district divisions, they can be comprehensively dis-

tributed into five great groups;—the polled or hornless, in Galloway, Suffolk, and Norfolk; the crumpled-horned, in Alderney and some parts of the south of England; the short-horned, in Durham, eastern Yorkshire, Lincolnshire, and the northern English counties; the middle-horned, in Herefordshire, Gloucestershire, northern Devon, eastern Sussex, Wales, and most of Scotland; and the long-horned, in Ireland, Lancashire, and the midland counties of England. But only in their native districts, or on a few select estates, are these to be found pure; and everywhere else they are so thoroughly and intricately intermixed as to form a countless and bewildering number of mongrel varieties. The polled breed has existed in some districts from time immemorial, and, in particular, is strongly identified with Galloway, and yet may have originally been a mere accidental variety; the crumpled horned breed is a native of Alderney; the short-horned breed seem to have been originally imported into the district of Yorkshire around Hull from some part of the western continental Europe between Denmark and France; and the long-horned and the middle-horned breeds compete, among keen and numerous disputants, for the honour of being the aboriginal breed of British cattle.

Mr. Youatt assigns the long-horns to Ireland, and claims the middle-horns as the aboriginal British. "Britain," says he, "has shared the fate of other nations; and oftener than they, although defended by the ocean on every side, she has been overrun and subjugated by ferocious invaders. As the natives retreated before the foe, they carried with them some portion of the wreck of their property; and this, in early times, consisted principally in cattle. They naturally drove along with them as many as they could, when they retired to the fortresses of North Devon and Cornwall, or the more mountainous region of Wales, or when they took refuge even in the wealds of East Sussex; and there retaining all their prejudices, and customs, and manners, they were jealous of the strict preservation of that which principally reminded them of their native country before it had yielded to a foreign yoke. In this manner probably was preserved the ancient breed of British cattle. Difference of climate gradually wrought some change, and particularly in their bulk. The rich pasture of Sussex fattened the ox of that district into his superior size and weight. The plentiful but not so luxuriant herbage of the north of Devon, produced a somewhat smaller and more active animal, while the occasional privations of Wales lessened the bulk and thickened the hide of the Welsh runt. As for Scotland, it, in a manner, set its invaders at defiance; or its inhabitants retreated for a while, and soon turned again on their pursuers. They were proud of their country, and proud of their cattle, their choicest possession; and there, too, the cattle were preserved unmixed and undegenerated. Thence it resulted,

that in Devon, in Sussex, in Wales, and in Scotland, the cattle has been the same from time immemorial; while, in all the eastern coast, and through every district of Britain, the breed of cattle degenerated, or at least lost its original character: it consisted of a variety of animals brought from every neighbouring and some remote districts, mingled in every possible variety, yet generally conforming itself to the soil and climate. The slightest observation will convince us that the cattle in Devonshire, Sussex, Wales, and Scotland are essentially the same. They are middle-horned; tolerable but not extraordinary milkers, and remarkable for the quality rather than the quantity of their milk; active at work; and with an unequalled aptitude to fatten. They have all the characters of the same breed, changed by soil and climate and time; yet little changed by the intermeddling of man. We may almost trace the colour, namely, the red of the Devon, the Sussex, and the Hereford; and even where the black alone are now found, the memory of the red prevails; it has a kind of superstitious reverence attached to it in the legends of the country; and in almost every part of Scotland, and in some of the mountains of Wales, the milk of the *red cow* is considered to be a remedy for every disease, and a preservative from every evil. Every one who has had opportunities of comparing the Devon cattle with the wild breed of Chatterhault Park or Chillingham Castle, has been struck with the great resemblance in many points, notwithstanding the difference of colour, while they bear no likeness at all to the cattle of the neighbouring country. For these reasons, we consider the middle-horns to be the native breed of Great Britain."

The Characteristics of Cattle.—The points which distinguish, or the properties which constitute, the best varieties of cattle, are, to some extent, matters of dispute, yet form an important subject of study to every judicious farmer, and ought, with as much exactitude as possible, to be determined and understood. Some secondary points affect appearance and beauty, and are matters of mere taste; other secondary points affect adaptation to particular climates or methods of feeding, or to the purposes of respectively the shambles and the dairy, and, in some instances, can be determined only by patient investigation and trial; and all the primary points affect constitution, healthiness, economy, and productiveness, and occur in all possible varieties of good cattle, and may be regarded as the mere indications of established natural laws, so that they ought to be distinctly known, not only in full-grown and fattened cattle, but in young and lean beasts, by every man who buys, keeps, or sells live-stock. Were a mere general observer to look upon a fat ox of prime character, he might admire its fine outline, the tint of its colours, the plumpness of its body, the smoothness and glossiness of its skin, the gentle expression of its countenance,

and the soft and cushiony yielding of its flesh to the pressure of the hand; but he could form no idea of the constitutional character whence these properties have evolved; he would wonder to be told that a judge can know, from its mere aspect, whether the ox be in good or in bad health,—from its colour, whether it be of a mixed or of an unmixed breed,—from its expression, whether it be a quiet feeder,—and from the nature of its flesh, whether or not it have arrived at maturity; and he probably might have difficulty in believing that, by the mere touch or handling of the animal, a judge can readily ascertain the quality of its flesh, and estimate the degree of ease and rapidity with which it fattened, and foretell the probable quantity of fat which will be found in the interior of the carcass. Were a general observer also to look upon a lean ox of precisely the same breed as the fat one, he might think its outline angular and coarse, and pronounce its body to be a rugged skeleton covered with a tough skin and disagreeable hair; while a judge can discern the points of the lean ox as readily as those of the fat one, and can anticipate, in accordance with them, the condition which the animal, if properly treated, will attain.—In the article on BREEDING, we glanced at the characteristics of a beau ideal ox, as an index of a breeder's aims; and now we must glance at the characteristics of good existing oxen, as an index of a stock-farmer's rules of selection from among the classified breeds of Britain.

One subject of consideration is purity of breed. This point is of small importance on its own account; yet it possesses much practical value as an index of known tendency to fatten; for when an ox is ascertained to be of unmixed descent, he must be regarded as possessing exactly the average fattening tendency of the breed to which he belongs. The colours of a pure breed, particularly around the eyes and on the bald skin of the nose, whatever the special colours may be, are always definite and without spots; and the horns in some pure breeds are wholly white, in others tipped with black, and, in all the long-horned and all the short-horned, smooth, small, tapering, and sharp-pointed. In the short-horns, for example, the colour of the body is either entirely white or entirely red, or predominatingly white or predominatingly red, and the tint around the eyes and on the bald skin of the nose is always a rich cream colour; and in the Ayrshire breed, the colour of the body is a mixture of unblended and variously sized spots of white and red, and the tint around the eyes and on the bald skin of the nose is generally black or cream colour.

The outline of a prime fat ox, of whatever breed, approaches a parallelogram. The back, from the top of the shoulder to the tail, is straight; the tail falls perpendicularly from the line of the back; the buttocks and twist are well filled out; the brisket projects to a line dropped from the middle of the neck; the belly is longitudinally

straight, and laterally round, and filled at the flanks; the ribs project horizontally, and at right angles to the back; the hooks are wide and flat; the rump, from the tail to the hooks, is flat and well-filled; the quarter, from the itch-bone to the hook, is long; the loin-bones are long, broad, flat, and well-filled; the space between the hooks and the short-ribs is rather short, and well arched over, in its posterior part, with a thickness of beef; the space from the loin to the shoulder-blade is nearly of one breadth; the space from the shoulder-blade to the front of the shoulder somewhat tapers or contracts; the neck-vein, in completion of the line from the neck to the brisket, is well filled forward; the covering on the shoulder-blade is as full out as the buttocks; and the middle ribs, in completion of the line from the shoulders to the buttocks along the projection of the outside of the ribs, are well filled.

The bones of a prime ox are flat, small, and hard; and constitute an important point for directing a judgment of lean cattle. A round thick bone indicates both slow feeding and inferior flesh; but a bone which appears flat when seen on a side view, and narrow when seen either from behind or from before, indicates rapid feeding and superior flesh. The bones, regarded in the aggregate, are small-grained and hard, and constitute a small proportion of the bulk and weight of the carcass. The bones of the head are fine and clean, and are covered, not with masses of fat, but only with skin and muscle; and the forearm and the hock are also clean and full of muscle. The neck, unlike that of the sheep, has no effect on the strength of the spine; and, contrary to the configuration of a prime sheep's neck, it is small from the back of the head to the middle of the neck.

The eye of a prime ox is clear, calm, and prominent; and is always attendant on fine bone, and nicely indicative of good breeding. A dull, heavy eye decidedly indicates slow feeding; a rolling eye, showing much white, is expressive of a restless and capricious disposition, and indicative of unsteady and somewhat difficult feeding; and a calm, complacent eye is expressive of a sweet and patient disposition, and indicative of steady, rapid, and kindly feeding. A clear and cheerful eye accompanies good health; and a dull, heavy eye—of a different cast from the eye of constitutional phlegmatic dulness—indicates the probable existence of some internal lingering disease.

The skin of a prime ox affords a criterion of a seemingly fanciful kind to the uninitiated, but of perfect certainty and great moment to a judge,—the criterion which is technically and emphatically called *the touch*. "The touch," says Mr. Dickson, "may be good or bad, fine or harsh, or, as it is often termed, hard or mellow. A thick, firm skin, which is generally covered with a thick set, hard, short hair, always touches hard, and indicates a bad feeder. A thin, meagre, papery

skin, covered with thin, silky hair, being the opposite of the one just described, does not, however, afford a good touch. Such a skin is indicative of weakness of constitution, though of good feeding properties. A perfect touch will be found with a thick, loose skin, floating, as it were, on a layer of soft fat, yielding to the least pressure, and springing back towards the fingers like a piece of soft, thick chamois leather, and covered with thick, glossy, soft hair. Such a collection of hair looks rich and beautiful, and seems warm and comfortable to the animal. It is not unlike a bed of fine soft moss; and hence such a skin is frequently styled 'mossy.' The sensation derived from feeling a fine touch is pleasurable, and even delightful, to an amateur of breeding. You cannot help liking the animal that possesses a fine touch. Along with it is generally associated a fine symmetrical form. A knowledge of touch can only be acquired by long practice; but after having acquired it, it is of itself a sufficient means of judging of the feeding quality of the ox; because, when present, the properties of symmetrical form, fine bone, sweet disposition, and purity of blood are the general accompaniments."

A good ox shows a fair proportion between the extremities and the body, and a symmetry of parts and members among the extremities. The head is small, and appears as if easily carried on the neck; the face, from the eyes to the tip of the nose, is long; the skull is broad across the eyes, contracts but little above them, and considerably tapers below them to the nose; the muzzle is fine and small, and the nostrils large; the crown of the head is flat and strong; the horns, whatever be the direction of their growth, protrude horizontally from the sides of the crown; and the ears are large, somewhat erect, considerably thin, and somewhat translucent. The neck is light, and tapers from the front of the shoulder and neck-vein, with a gradual rise from the top of the shoulder to the head. The legs below the knee are clean made, and rather short than long; and they stand wide asunder, and seem so placed as most easily and effectually to support the whole weight of the body. The tail is comparatively thick, in indication of a strong spine and great weight; and, in most good instances, it terminates in a large tuft of long hair.

A prime ox for the shambles has comparative bulkiness in the members and parts whose flesh is of chief value. "The position of the flesh on the carcass," remarks Mr. Dickson, "is a great consideration in judging of the ox, the flesh on the different parts being of various qualities. That part called the spare-rib in Edinburgh, and the fore and middle ribs in London, the loins, and the rump or hockbone, are of the finest quality, and are generally used for roasts and steaks. Consequently, the ox which carries the largest quantity of beef on these points is the most valuable. Flesh of fine quality is actually

of finer texture in the fibre than coarse flesh; it also contains fat in the tissue between the fibres. This arrangement of fat and lean gives a richness and delicacy to the flesh. The other parts, though not all of the same quality, are used for salting and making soups, and do not fetch so high a price as the parts just described. A full twist lining the division between the hams, called the 'closing,' with a thick layer of fat, a thick flank, and a full neck-vein, are generally indicative of tallow in the interior of the carcass; but it frequently happens, that all these symptoms of laying on internal fat fail. The disposition to lay on internal fat altogether depends on the nature of the individual constitution; for it is often observed, that those individuals which exhibit great fattening points on the exterior do not fill with internal fat so well as others which want these points. On the contrary, thin-made oxen, with flat ribs and large bellies, very frequently produce large quantities of internal fat. The first part which shows the fat in a feeding ox, is the point or top of the rump, which, in high-bred animals, is a prominent point; sometimes it protrudes too much, as the mass of fat laid on these is out of proportion to the lean, and therefore useless to the consumer. This is the part which frequently misleads young or inexperienced judges in the true fatness of the ox, because fat may be felt on this part, when it is very deficient on most of the other points. The parts, on the other hand, which are generally the last in being covered with flesh, are the point of the shoulder-joint and the top of the shoulder. If these parts are, therefore, felt to be well covered, the other and better parts of the animal may be considered ripe. Ripeness of condition, however, can only be rightly ascertained by handling, for there is a great difference between the apparent and real fatness of an ox. The flesh of an apparently fat ox to the eye, may, on being handled by a judge, feel loose and flabby; but a truly fat ox always feels 'hard fat.' With such the butcher is seldom deceived; while loose handlers give no assurance of killing well."

Polled Cattle.—The polled or hornless breeds of cattle are either jointly aboriginal in Britain with the middle-horns, or, as already hinted, they are more probably the offspring of an ancient accidental variety. They have existed from time immemorial in Galloway; they have, for a very long period, been favourites in various districts of the east and south-east of Scotland, particularly in Aberdeenshire and Forfarshire; they have, for upwards of a century and a half, been sent in great numbers from Galloway far into England, especially to the counties of Norfolk and Suffolk; and they are in high esteem, throughout many parts of both Scotland and England, for their large size, the firmness of their flesh, and the readiness of their disposition to fatten. They are generally designated, in Scotland, dodded cattle and humble cattle, or

familiarly doddies and humlies. The principal varieties or breeds of them, or those which are most distinctively known in the market, are the Buchan doddies, the Angus humlies, the Galloways, the Suffolks, and the Norfolks.

The Buchan or Aberdeenshire doddies are generally symmetrical. *Plate XIV. Fig. 2.* Their back is straight, but has the rump-top and the tail-head rather too much elevated. The ribs have a roundish outline, and are a little flat near the backbone. The side-view is pretty rectangular; but the brisket is deeper than the flank, and the rump-top and tail-head are higher than the back and the shoulder-tops. The back, as seen from above, is a little too narrow, and, from the hooks to the shoulder, is wedge-shaped. The eye is good; the touch is, in general good; the bones are strong and well-set; and the flesh is well developed in the most valuable parts. The colour is generally black, but sometimes red, dun, and brindled, with scarcely any white. A well-fed ox of this breed usually attains, at four years of age, a weight of between 50 and 60 stones; but, in favourable circumstances, it attains a weight of between 70 and 80 stones; and, in some instances, it attains, at five or six years of age, a weight of 100 stones. This breed find their way into every part of the south of Scotland; and their beef is of fine quality, and adapted either for the home market or for shipping.

The Angus humlies have external characters intermediate between those of the Buchan doddies and those of the Galloways; and, probably by means of a cross with the latter, they have been much improved from what they once were. They extend over all Forfarshire, all Kincardineshire, a large portion of Aberdeenshire, and many parts of Fifeshire; and large droves of them are annually sent to the south of Scotland and to England, and are generally confounded in the latter country with Galloways. They have, for some time past, been constantly under a course of improvement; and they are, at present, so far from being a fixed or finished breed, that the propagators of them, even in Forfarshire, cannot always depend on the precise points of the parents being perpetuated in the offspring. The back of most of them is a little depressed over the loins; the rump-top and the tail-head are rather too high; the shoulder-top is a little below the line of level; the buttocks are too thin; and the brisket is not sufficiently forward. The body, viewed either in front or in rear, is too narrow,—the hook-bones not being broad enough, the ribs flattish at the back, and both the hind legs and the fore legs not sufficiently asunder; and, viewed from above, it is somewhat wedge-shaped, the breadth across the shoulder being less than that across the hooks. The legs are well-boned and of moderate length; the muzzle is rather coarse; the eye is good; the ears are rather too thick and hairy; the head is tufted with hair and pretty well shaped; and the neck is rather



The first of these is the *Phocaena*, which is a small, sleek, and agile animal, with a long, pointed snout, and a pair of small, dark eyes. It is found in the shallow waters of the coast, and is known for its ability to leap out of the water and catch fish. The second is the *Phocaena*, which is a larger, more robust animal, with a thick, wrinkled skin, and a pair of large, dark eyes. It is found in the deeper waters of the coast, and is known for its ability to swim long distances. The third is the *Phocaena*, which is a small, sleek, and agile animal, with a long, pointed snout, and a pair of small, dark eyes. It is found in the shallow waters of the coast, and is known for its ability to leap out of the water and catch fish. The fourth is the *Phocaena*, which is a larger, more robust animal, with a thick, wrinkled skin, and a pair of large, dark eyes. It is found in the deeper waters of the coast, and is known for its ability to swim long distances. The fifth is the *Phocaena*, which is a small, sleek, and agile animal, with a long, pointed snout, and a pair of small, dark eyes. It is found in the shallow waters of the coast, and is known for its ability to leap out of the water and catch fish. The sixth is the *Phocaena*, which is a larger, more robust animal, with a thick, wrinkled skin, and a pair of large, dark eyes. It is found in the deeper waters of the coast, and is known for its ability to swim long distances. The seventh is the *Phocaena*, which is a small, sleek, and agile animal, with a long, pointed snout, and a pair of small, dark eyes. It is found in the shallow waters of the coast, and is known for its ability to leap out of the water and catch fish. The eighth is the *Phocaena*, which is a larger, more robust animal, with a thick, wrinkled skin, and a pair of large, dark eyes. It is found in the deeper waters of the coast, and is known for its ability to swim long distances. The ninth is the *Phocaena*, which is a small, sleek, and agile animal, with a long, pointed snout, and a pair of small, dark eyes. It is found in the shallow waters of the coast, and is known for its ability to leap out of the water and catch fish. The tenth is the *Phocaena*, which is a larger, more robust animal, with a thick, wrinkled skin, and a pair of large, dark eyes. It is found in the deeper waters of the coast, and is known for its ability to swim long distances.

too small at the junction with the head, and does not carry the latter with sufficient gracefulness and ease. The hair is short and smooth; the hide is thickish; and the touch has a medium character between soft and harsh. Some individuals are wholly or almost wholly black; some are prevailingly black, but have a few dead-white spots on the face and the belly; some are yellow-red; and some have a dull and rich hue of dark red. The disposition is quiet; and the tendency to fatten rather slow.

The Galloway cattle were, till quite a recent period, a mixture of polled and horned varieties; and they have eventually become wholly polled, simply by the rejection of horned individuals in propagation. Small or rudimental horns still occasionally appear in the breed; but they have the curious character of being attached only to the skin. The Galloways, though scarcely distinguishable from the best or most improved individuals of the Angus humlies, are, as a whole, a decidedly better breed; and, at the same time, they have purity of blood, and steadily transmit their points from parent to offspring. They are also of finer quality than the Buchan doddies, though usually inferior to them in weight; and while the latter are well adapted for strong ship beef, the former are excellently suited for the shambles of the retail butcher. The Galloways are spread over all Wigtonshire, all Kircudbrightshire, the southern part of Ayrshire, and a considerable part of Dumfries-shire. But by far the greater number, when two or three years old, are driven away from the land of their birth to be fattened on the pastures of Norfolk and Suffolk, and then sold in the market of Smithfield under the name of Norfolk Scots. They constitute upwards of one-third of all the cattle of Smithfield from March till July; and, when in thorough condition, or what is technically called 'hard fat,' they are highly esteemed by the London butchers.—The back of a true Galloway is quite straight and level, or at least has its shoulder-top nearer the level than the Angus humlies. The ribs are well rounded; and the quarter is longer and the loins more shortly coupled, than in the Angus breed. The brisket is well forward, and the buttocks are well filled down to the hock; so that the whole body has the appearance of being deep. The buttocks are round, the back across not flat but rounded, and the breast full and expanded; so that the body, when viewed either in rear or in front, is broader than that of the Angus humlies. The breadth of the hooks also is carried forward to the shoulder more than in the Angus, so as to render the outline more rectangular, as seen from above. The head is better set on the neck than in the Angus, but is rather large, and has a coarse appearance. The muzzle is not good; the eye is dull, shows no white, and indicates sullenness; the ears are thick and hairy; and the head is crowned with a rather large semispherical knob, tufted with

hair. The legs are strong and short, and they are more deeply enveloped with the carcass than those of almost any other breed. The skin is well protected with soft longish hair, and the touch is mossy and good. The prevailing colour is black, with sometimes a line of a dull dusky hue running along the back.

The polled cattle of Norfolk seem to have gradually superseded a middle-horned breed of similar character to that of the Devons; yet though generally and highly preferred for fattening, they are far from being the only cattle of the county. They are strictly descendants of the Galloways; yet, while retaining the form of that breed, and superior to them in size, they have very observably lost some of their excellencies. They are taller than the Galloways, rather better milkers, and capable of accumulating a greater load of flesh; but they are thinner in the chine, flatter in the ribs, longer in the legs, more difficult to fatten, and somewhat inferior in the quality of their beef. Most are red in colour, but some are black; and others have mixtures of red or black with white, and possess a peculiar golden-coloured circle around the eye.

The polled cattle of Suffolk, (*Plate XIX. Fig. 1.*) are also descendants of the Galloways; but they are broader and rounder in the body than the Norfolks, shorter in the leg, more easily fattened, and usually attain a greater weight. They very nearly resemble the Angus humlies in most external characters except size. A description of those which existed nearly a century ago, says that they had "a clean throat, with little dewlap, a snake head, thin and short legs, the ribs springing well from the centre of the back, the carcass large, the belly heavy, the backbone ridged, the chine thin and hollow, the loin narrow, the udder square, large, loose, and creased when empty, the milk veins remarkably large and rising in knotted puffs." The prevailing colours are dun, red, red and white, brindled, and creamy yellow. Most of the bull calves, however, are fed for veal for the London market; and nearly all the heifers are reserved for the dairy, for the supply of London with butter. Many and wondrous statements have been made respecting the milking properties of the Suffolk cow; but most of these are wild exaggerations, and such as are true ought to point rather to the luxuriance of the pastures than to the excellence of the breed.

Crumpled-Horned Cattle.—The crumpled-horned or Alderney cattle are constantly imported to Britain from the Channel Islands, Normandy, and adjacent parts of the French continent; yet though brought from so many districts are always popularly called Alderneys. They are somewhat extensively diffused in Hampshire; but they exist in other British districts only in gentlemen's parks and pleasure-grounds, and they seem ill adapted to the climate of Scotland or of the extreme north of England. They are small

in size, very ill shaped, and altogether destitute of some of the best points of cattle character; but their milk is surpassingly rich, and yields more butter in proportion to quantity than that of any other kind of cows; and partly on this account, partly for fashion's sake, they are generally esteemed as occupants of fine parks. Mr. Parkinson, speaking somewhat exaggeratingly, says, "They are of as bad a form as can possibly be described; the bellies of many of them are four-fifths of their weight; the neck is very thin and hollow; the shoulder stands up, and is the highest part; they are hollow and narrow between the shoulders; the chine is nearly without flesh; the hucks are narrow and sharp at the ends; the rump is short; and they are narrow and light in the brisket."—"When viewed from behind," says another writer, "their body appears like two boards nailed together, as thin as a lath." Their skin is very thin and papery; their hair is short and smooth; their cast of countenance is timid; and their colour is, for the most part, a light-brownish-red, mixed sometimes with white, and sometimes with white and dun.

Short-Horned Cattle.—The short-horned cattle have, in recent times, acquired much more celebrity than any other breed. Their origin in Britain belongs to the counties of York and Durham, but is very obscurely known. Toward the close of the 17th century, or perhaps at an earlier period, a bull and some cows, which appear to have been one source of the breed, were introduced to Holderness from some part of continental Europe between Denmark and France. They had large shoulders, flat sides, a coarse neck, and a thick head; their coarse parts were too large, and their fine points too small; yet they were better milkers, larger in size, and more capable of being fattened to an enormous bulk than almost any other cattle which were then known; and, on these accounts, they were esteemed, propagated, and intermixed with such of the native cattle as most nearly resembled them.—A race of cattle, of totally unknown origin, and constituting another source of the modern short-horns, existed from time immemorial within the basin of the Tees, on the mutual border of the counties of York and Durham, and acquired the appropriate name of Teeswater cattle. "In colour," says the Rev. Henry Barry, "they resembled what is called the improved breed of the present day, except that the fashionable roan was not quite so prevalent. They are described in general characters also to have differed very little from their descendants; possessing a fine mellow touch, good hair, light offal, particularly wide carcasses, and deep fore-quarters. They were also justly celebrated for extraordinary proof when slaughtered,—resembling thus closely their descendants of the present day. One trifling difference is alone worth recording,—the horns of the old Teeswater breed were rather longer, and turned gaily upwards."—During the latter part of last century,

numerous bulls, which proved a third source of the present short-horns—but a source in some degree identical with the first—were imported to the counties of York and Durham from Holstein and Holland. The frame of the cattle of the present day in Holstein and Holland is superior to that of the old Teeswater breed, and somewhat similar to that of the modern improved short-horns, but inferior to the latter in several of the best points. The colours of the Dutch, too, are black and white, while those of the Teeswater were red and white.—Improvements of successive stages, but of unrecorded pedigree, were made by crossings of the Teeswater with the Dutch and the Holstein, till a new and established breed was produced, called the Teeswater Short-horns; and this latter breed was afterwards improved, by a series of recorded and widely-known crossings, commencing with the red and white bull Studley, belonging to Mr. Sharter of Chilton, till it resulted in the present race of Short-horns,—the finest and most celebrated breed of cattle now pastured in Britain.

The frame of a thorough-bred fattened short-horn, exactly corresponds to the established rules respecting rectangularity of outline. "When we survey the frame, we have a straight level back from behind the horns to the top of the tail, full buttocks, and a projecting brisket,—we have, in short, the rectangular form; we have also the level loin across the hookbones, and the level top of the shoulder across the ox, and perpendicular lines down the hind and fore legs on both sides, these constituting the square form when the ox is viewed before and behind; and we have straight parallel lines from the sides of the shoulders along the outmost points of the ribs to the sides of the hind quarters, and we have these lines connected at their ends by others of shorter and equal length, across the end of the rump and the top of the shoulder, thus constituting the rectangular form of the ox when viewed from above down upon the back. We have, in this manner, the form of the short-horn ox and heifer in perfect accordance with the diagrams of the rule." But the bull (*Plate XIV. Fig. 1.*) deviates in an elevation of the neck, a dependence under the brisket, and a fulness of the neck vein; and the cow, when young, slightly deviates in a thinness in the buttocks,—and when old, considerably deviates in an enlargement of the belly, and generally, though not always, in a hollowness in the loins. The flesh of the short-horn, whether ox, heifer, bull, or cow, is accumulated and well adjusted in the most valuable parts; the fat of it is in due and even preponderating proportion to the lean; and the fibres of the lean are fine, well mixed or even marbled with fat, and abundantly juicy. The bone of the head and the legs is fine, thin, and clean; the expression of the eye is calm, pleasant, and comparatively intelligent; the horns are finely tapering, and either white or otherwise light coloured;

and the colour of the skin is red or white, or various commixtures of red and white, while that of the bare portion of the nose and around the eyes has the tint of cream. "The external appearance of the short-horn breed," remarks Mr. Dickson, "is irresistibly attractive. The exquisitely symmetrical form of the body in every position, bedecked with a skin of the richest hues of red and the richest white, approaching to cream, or both colours, so arranged or commixed as to form a beautiful fleck or delicate roan, and possessed of the mellowest touch; supported on small, clean limbs, showing, like those of the race-horse and the greyhound, the union of strength with fineness; and ornamented with a small lengthy tapering head, neatly set on a broad, firm, deep neck, and furnished with a small muzzle, wide nostrils,—prominent, mildly-beaming eyes,—thin, large, veiny ears, set near the crown of the head, and protected in front with semi-circularly bent, white or brownish-coloured, short, smooth, pointed horns;—all these several parts combine to form a symmetrical harmony, which has never been surpassed in beauty and sweetness by any other species of the domesticated ox."

The short-horned breed are the prevailing cattle of Yorkshire and Durham; they have become common in many parts of the counties adjoining these, particularly Northumberland, Cumberland, and Lincolnshire; they more or less abound in Essex, Middlesex, Surrey, and some other districts remote from the places in which they originated; and they have, for some time past, been in general requisition on estates in most parts of the three kingdoms, which are in any tolerable degree distinguished for attempts to improve local breeds by crossing. Till about forty years ago, few were seen north of the Tweed; but, for a considerable time past, they have existed in as great perfection in Berwickshire and Roxburghshire as in the counties of York and Durham, and have been more or less intermingled with the prevailing live stock of the Lothians, Fifeshire, Perthshire, and other districts of the Scottish lowlands, and have even penetrated from county to county till they have become not unknown in the vicinity of John-o'-Groats.

Middle-Horned Cattle.—The middle-horned cattle of North Devonshire (*Plate XIII. Fig. 2.*) seem to be direct descendants of the aboriginal cattle of Great Britain; and they are usually regarded as a very distinct and favourable variety of the middle-horns. They exist in greatest purity in the district extending from the river Taw westward along the sea-board of the Bristol Channel to a point east of Parrett, and landward, by Barnstaple, South Molton, Chumleigh, and Tiverton, to a point not far from Wellington. They are esteemed, in their native district, in Norfolk, and in some other parts, for the richness and volume of butter yielded by their milk; they are favourites, in some parts of England, for the

draught; they have been tried in some districts, even so far distant as the extreme west of Ireland, for the improving of other breeds; and they have themselves been eventually so much improved that, in their own country, they would probably suffer deterioration from any crossing with any other distinct variety. They have been tried in Scotland; but they do not seem to agree with its climate. They have yellowish horns, a pure, rich red colour, and tolerably good symmetry and points. They are inferior to the short-horns for feeding, and to the Herefords for the shambles; and, though fleshy, they cannot compare with either the short-horns or some of the Scotch middle-horns, for fine mixture of fat and lean. "The horn of the bull," says Youatt, "ought to be neither too low nor too high, tapering at the points, not too thick at the root, and of a yellow or waxy colour. The eye should be clear, bright, and prominent, showing much of the white, and it ought to have around it a circle of a variable colour, but usually a dark orange. The forehead should be flat, indented, and small; for by the smallness of the forehead, the purity of the breed is very much estimated. The cheek should be small, and the muzzle fine; the nose should be of a clear yellow. A black muzzle is disliked, and even a mottled one is objected to by some who pretend to be judges of the true Devon. The nostril should be high and open; the hair curled about the head, and giving, at first appearance, an idea of coarseness which soon wears off. The neck should be thick, and that sometimes almost to a fault. Excepting in the head and neck, the form of the bull does not materially differ from that of the ox, but he is considerably smaller."

The Hereford cattle (*Plate XIX. Fig. 1.*) are more similar than any other middle-horns to the short-horn breeds; and they were unaccountably mistaken by Mr. Culley for a cross between the Welsh and a bastard variety of the long-horns. They pay the feeder better than the breeder; for their cows are very bad milkers; while their oxen and heifers, when in good condition, are exceedingly well adapted to the shambles. They have their beef well developed in the best points; and though a heavy breed, they generally sell at first-rate prices in Smithfield. They seem well adapted in form and strength for heavy farm work; but they want sufficient activity, and are now very seldom seen in the yoke. "The countenance of this breed," says Mr. Marshall, "is pleasant, cheerful, open; the forehead broad; eye full and lively; horns bright, taper, and spreading; head small; chop lean; neck long and tapering; chest deep; bosom broad, and projecting forward; shoulder-bone thin, flat, no way protuberant in bone, but full and mellow in flesh; chest full; loin broad; hips standing wide, and level with the chine; quarters long, and wide at the neck; rump even with the level of the back, and not drooping, nor standing high and sharp

above the quarters; tail slender and neatly haired; barrel round and roomy; the carcass throughout deep and well spread; ribs broad, standing flat and close on the outer surface, forming a smooth, even barrel, the hindmost large and full of length; round bone small, snug, and not prominent; thigh clean and regularly tapering; legs upright and short; bone below the knee and hock small; feet of middle size; flank large; flesh everywhere mellow, soft, and yielding pleasantly to the touch, especially on the chine, the shoulder, and the ribs; hide mellow, supple, of a middle thickness, and loose on the neck and huckle; coat neatly haired, bright, and silky; colour, a middle red, with a bald face."

The Sussex cattle, particularly those among the wealds of East Sussex, appear equally with the North Devons to be direct descendants of the aboriginal cattle of Great Britain. They are much less adapted than the Herefords and some other varieties of middle-horns, for the purposes of the retail butcher; yet possess excellent adaptation for the purposes of the beef-shipper. They are a large breed, generally of a red colour, with no white on the face; and they have larger horns than the Herefords, plainer skins, larger bones, less symmetry, and fewer points of excellence in habit or goodness of flesh. Their horns project and then turn up, and are thin, long, and tapering; and though quite distinct in form and character from those of the long-horned breeds, yet possess very considerable resemblance. Their eye is large and prominent; their neck is coarser than that of the North Devons, and both longer and thinner than that of either the short-horns or the long-horns; and their shoulder has no projecting point as seen from behind, but is the centre of a disproportionately large development of a secondary quality of flesh.

The prevailing cattle of Cornwall, Devonshire, Somersetshire, most of Gloucestershire, and part of Kent are middle-horn varieties, either closely allied to the North Devons, the Herefords, or the Sussexes, or produced from a crossing of some two of these with each other, or of one of them with the middle-horns of Wales.—The Welsh cattle have the same kind of claim as the North Devons and the Sussexes to be considered direct descendants of the aboriginal British cattle; and when examined from county to county, as they exist in the interior of the principality, they are seen to be a group of varieties, considerably different from one another in points and character, and possessed, in some instances, of considerable value; but when observed only in the specimens which are driven into England, and sold fat at Smithfield, or lean at the markets of Rumford and Epping-Forest, they appear to be of nearly uniform variety, and all of very inferior character. English graziers and feeders who can obtain Scottish West Highland cattle, never think of purchasing cattle from Wales. "The Welsh cattle," observes Mr. Dickson, "resemble the small-

est and coarsest sorts of our Fife and Aberdeenshire runts, having thick horns, thick, coarse, plain hides, and narrow backs; and, in my opinion, they are a very inferior breed of cattle."—The native Scotch cattle, with the exception of the polled varieties formerly noticed, are all middle-horned, and rank, in origin and general character, with the North Devons and the Sussexes; but whether viewed at large on their native pastures, or in specimens as driven into England, they are classifiable into a number of groups, so very distinct from one another as to be usually regarded as different breeds. The most remarkable or important of these groups are the Shetlanders, the cattle of Orkney and Caithness, the North Highlanders, the middle-horns of Aberdeenshire, the middle-horns of Fifeshire, the West Highlanders, and the cattle of Ayrshire.

The Shetlanders, though easily capable of improved growth on good pastures, are naturally the smallest cattle in the Three Kingdoms; yet, in the quality of their beef, the fineness of its grain, the delicacy of its flavour, and the prime intermixture of its fat with its lean, they are totally unsurpassed and even unequalled. Their form, as tested by the established rules, is defective in symmetry; the line of the back is rather hollow; the ribs are pretty round; the tail head droops; and the forequarters and the belly are comparatively too large. This form indicates starvation, and may have been accidentally produced by severity of climate and paucity of food; and, under more favourable circumstances, especially with the aid of crossing, it might easily be improved. The horn is sharp, the eye full, the muscle fine, the hair soft and sleek, and the touch excellent; and these points combine with others to indicate great superiority of constitution and much tendency to fatten. The colour is uniformly black, light red, or black and white. The weight of the forequarters is usually from 16 to 20 stones, and when extra fat, from 25 to 30 stones; yet, in some instances of full fatness, it is not more than 14 or 15 stones. The beef is, in every part, of the finest quality, and as small-grained as mutton. The milk of the cow is rather small in quantity, but very rich in quality.

The cattle of Orkney are much larger than those of Shetland, but have far less symmetry of form, and a much coarser quality of beef. Their back is narrow, and curves above the straight line; their ribs are flat; their hind quarters are thin; all their bones are coarse, and those of the trunk are prominent; their head droops; and their horns are short and blunt. Their poor coat and their bad shape, indicate them to be slow feeders, and incapable of acquiring an early maturity.—The Caithness cattle have narrow backs, flat ribs, narrow chests, and large bellies; and, in general, are similar to those of Orkney. A large proportion of both varieties are trained to work or kept for breeding till about seven or eight years of age; and are then sold in a lean

condition, under the name of runts,—an expressive Scotch word which properly means old cows that have ceased to be capable of breeding. The runts are often sold at a very low price; yet when transferred to good pastures in the south of Scotland or in England, they rapidly fatten, and acquire a mass of tolerably good beef, and become very compensatory to the feeder.

The native breed of the counties of Sutherland, Ross, and Cromarty, bear the name of North Highlanders, and are scarcely distinguishable from the cattle of Orkney and Caithness. But two other breeds in Sutherlandshire, the Dunrobins and the Skibos, are so peculiar and interesting as, in spite of their comparatively small numbers, to challenge specific notice.—The Dunrobins take their name from the Duke of Sutherland's estate of Dunrobin Castle, and are well known, as very superior Highlanders, both in England and in Southern Scotland. They attain a great size at Dunrobin, at Skelbo, and at some other places in the north; and, when brought down to the southern markets, have frequently excited surprise and admiration. "I remember," said Mr. Dickson in 1835, "a lot of sixty four-year olds being shown about twelve years ago at the October Falkirk Tryst. They had the most sprightly and splendid appearance of any north country cattle I ever saw. They showed beautiful symmetry, straight level backs, round deep carcasses, great substance of flesh, strong fine bone, fine coats of hair, with small muzzles, quick eyes, and large, sharp-pointed, spreading horns. The only fault which could have been found in their symmetry was the large proportion which the fore bore to the hind quarters. They were fine fat, and would have weighed 55 stones the four quarters."—The Skibos are bred on the estate of Skibo, and have, for a considerable period, been driven annually to the centre of Forfarshire, and there sold at exorbitant prices for private consumption at gentlemen's tables. They are nearly as small as the Shetlanders, and almost as fine in the quality of their beef, and, at the same time, far more symmetrical and beautiful in form. They have a straight level back, pretty round ribs, small bones, a sharp muzzle, keen bright eyes, fine, small, sharp-pointed, spreading horns, a soft, thick, hairy coat, and a sweet touch; and they possess most of the good properties of rapid feeders. When viewed from above, they are disproportionately narrow and long; yet, when well fattened, they have the tops of the ribs well covered, and show remarkably fine points.

The horned cattle of the mountainous districts of Aberdeenshire are a middle-sized variety, rather plain skinned, of pretty good symmetry, usually weighing from 30 to 50 stones when fat, excellent travellers, well adapted to the shambles, and in much favour with the graziers, not only of their native districts, but of the counties of Banff and Elgin. But the horned cattle of the interior of Aberdeenshire, about Huntly and Keith, and in

other low-lying districts, are a large, heavy variety, commonly designated Aberdeenshire runts. They have large, long bodies, great ends, small middle, strong bones, long legs, a gaunt, stalking gait, smooth hair, large hooves, thick muzzle, dull, heavy eyes, and very thick, broad, long, spreading, turned-up horns. Many are worked in the plough till seven or eight years of age, and then fattened for the shambles, or driven away to the south.

An old and celebrated breed of Fifeshire cattle, called the Falklands, are supposed to have been imported by some of the kings of Scotland, to their favourite hunting seat of Falkland, from Hereford, Sussex, or North Devon; and they possess considerable resemblance to the breeds of these districts in both form and character; but they have become very scarce, and are likely soon to disappear. The prevailing horned cattle of Fifeshire are a coarse variety, which, in common with the ill-shaped and half-haggard varieties of Caithness and Aberdeenshire, bear the contemptuous designation of runts. Their general outline is inferior to that of many of the northern varieties; the direction of the back is curved, and falls below the level line; the bones are coarse; the legs are rather long; the eye is dull; the face has strongly marked features; the horns are long, flat, and thick; the hair is smooth; the touch is rather hard; the tendency to fatten is comparatively feeble till the third or fourth year; and the beef is by no means good for the retail butcher, but suits well to be salted and shipped.

The West Highlanders or Kyloes are both the oldest and the best middle-horn breed in Scotland. *Plate XIII. Fig. 1.* They include several varieties, and have undergone different kinds and degrees of improvement. The purest variety of them, though small in size and otherwise inferior, exists in Skye; other varieties of a comparatively small size exist in other parts of the Hebrides; varieties of comparatively large size are found on the richer pastures of Ross-shire, Argyleshire, and Perthshire; and varieties both large and small, occur in the counties of Inverness, Sutherland, Stirling, and Dumbarton, and in portions of some other Highland counties. The back of a good Kyloe is straight and level; the upper surface of the back is broad, all the way from the top of the shoulder to the rump; the sides are deep; the brisket is wide, and projects well forward; the buttocks are well filled up; the legs are short, and have strong, broad, fine bones; the muzzle is fine; the nose is a little turned up; the eye is full and sparkling; the ears are thin, broad, hairy, and pricked; the horns are wide-set, long, white, tapering, sharp-pointed, and tipped with black; the hair of the coat, the head, the mane, the dewlap, and the tail-end is shaggy, long, fine, and not in the least degree curled; the skin is mellow; the touch is soft and kindly; the colours are frequently black, and sometimes red, dun, or brind-

led, and always of a rich hue; the habit has a great aptitude for early fattening; and the beef is of the finest quality, and accumulated on the most valuable parts. "Taking them all in all," says Mr. Dickson, "no breed which I have yet noticed, (comprising all the Scotch breeds except the Ayrshires and the Galloways,) approaches in character and properties so near the short-horns as the West Highlanders. The climate of that part of the country which they inhabit is not cold, but wet and boisterous; and, as a suitable protection against the elements, their shaggy coats are well adapted. They are first-rate grazers, feeding on grass with great rapidity on their native pastures; and, when they are brought into the arable districts, they thrive equally well on turnips. The usual weight which they attain, when fat, is from thirty to fifty stones, according to the size of the particular variety."

The Ayrshire breed of cattle has a very distinct character from that of any of the other middle-horn breeds; yet it is evidently allied to them, and seems to have risen out of one or more of them; and, though both the time and the manner of its origin are strangely and deeply enveloped in obscurity, it is known to have had no existence about a century ago, and to have come into existence within the county whence it has its name. It has very extensively, and for a considerable period, though somewhat erroneously, had the reputation of being the most lactiferous breed in Great Britain; and throughout Ayrshire, Lanarkshire, and Renfrewshire, large portions of Stirlingshire, Dumbartonshire, and Linlithgowshire, and small, occasional spots in some other districts, it is strictly and sedulously appropriated to the purposes of the dairy. The beef, though of good quality, and possessing a good admixture of fat and lean, makes bad returns to the butcher, and is very limitedly in request; and the bull-calves are usually fed for veal, while the heifer-calves are kept to renew the stock of cows. Short-horn cows are much larger than the Ayrshires, yet do not consume more food in proportion to their size; and they produce more valuable calves, yield larger quantities of milk, and give less trouble in proportion to their yield of milk; and a stock of them as compared to a stock of Ayrshires occupy less room, involve less risk of loss from disease and death, and afford both a larger and a more valuable produce. The short-horns, therefore, ought, in all common sense, to supersede the Ayrshires on every large or middle-sized dairy-farm; and the Ayrshires ought to be retained as milkers only on cottage-holdings, moor-side farms, and any other situations of very limited capacities for food and very small demands for milk. The back of prime Ayrshire cattle is straight and nearly level yet has one slight depression at the top of the shoulder, and an evident tendency to another over the loins; the ribs are pretty round; the sides are deep, but show a deficiency in the filling up of the buttocks; the

breast or front of the carcass is comparatively narrow; the upper surface of the carcass shows far less breadth at the shoulder than at the hooks, and has a kind of wedge-shaped outline; the length of the body is proportionately greater than the height; the legs are comparatively short; the muzzle is fine; the face is broad but rather short; the eye is complacent; the expression of the face is gentle but dull; the horns are short and turned up; the skin is smooth and thin; the touch is good, yet wants the mellowness which accompanies a thick and soft skin; and the colours are red and white like those of the short-horns, but not so rich in hue, and sometimes mixed with black, and always arranged in blotches and patches, which are irregular, seldom circular, and never grizzled.

Three very distinct breeds of cattle prevail in Ireland; and one of these is middle-horned. This seems to be as evidently aboriginal in Ireland as in Great Britain; it is small, wild, light, and active; it occurs in almost every district of the rude and mountainous regions of the island; and it may be regarded as very favourably represented in its best known variety, the cattle of Kerry. The Kerry cow is as small as a cow of the Scottish Skibos, and somewhat similar to her in points and shape; she is, comparatively to her size, a very copious milker; and she possesses the same kind of reputation throughout a large portion of Ireland, which belongs to the Ayrshire cow in the western districts of the Scottish lowlands. Kerry heifers are in constant demand, at comparatively high prices; and they may be met in droves, in many parts of the low country, ready to be sold in pairs or one by one to the small farmers of the rural districts and the dairy-keepers and cowfeeders in towns. Kerry cattle, when unmolested or very gently treated, are perfectly quiet; but, when disturbed or even slightly irritated, they break all bounds, and overleap all the ordinary fences. Their horns are small; their muzzle is sharp; their eyes have a quick and piercing expression; their horns are long, sharp-pointed, and turned-up; and their coats are finely hairy and soft.

Long-Horned Cattle.—Ireland appears, though not very distinctly, to have been the country of the aboriginal long-horned family of cattle; and it, at present, possesses two perfectly distinct breeds, which seem either to have had a separate origin, or to have for a very long period had a separate and mutually receding existence. The breed of the northern parts of the island, though occasionally producing individuals of a somewhat symmetrical shape, is prevailingly coarse, clumsy, dull, and exceedingly inferior. The head is large; the horns are long; the bones are coarse; the skin is coarse and thick; the body, viewed either in front or in rear, is exceedingly thin; and the colour is of almost every shade on the body, but generally white on the back. Large droves of them, of three and four years of age, are con-





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stantly exported, at very low prices, to be fattened by English graziers.

The other long-horned Irish breed prevails over all the great central plain of Ireland, from Dublin away into Connaught, and from the confines of Ulster away to the centre of Munster; it is, in many instances, particularly in the counties of Roscommon, Meath, Limerick, and Tipperary, a breed of great value,—quite worthy to be compared to many of the esteemed middle-horns of Great Britain; and it appears to have been the true or exclusive origin of the long-horns of England; and yet, as at present existing, it has acquired material improvement from crossings with some of the best long-horns of Lancashire. The back of an ox of this breed is straight and level; the bones are strong; the flesh is compactly accumulated; the skin is thick, rather hard, and profusely hairy; the shoulders are thick; the expression of the eye and countenance is placid; the horns first project outward, then form a curve, and then return to the face, threatening in some instances to pierce the bones of the nose, and in others so to pass before the muzzle as to prevent the animal from grazing; and the colour along the back is usually white, and athwart the body very various, but chiefly red and white blended into a coarse and unpleasant roan. The beef is of medium quality, juicy, and well-flavoured, but decidedly coarse in the grain; and when well fattened, it is in high request with the shipping butchers. The best specimens of this breed are usually to be seen in the Smithfield market of Dublin; exported droves of them constitute the principal supply of the shambles of Liverpool and Manchester; and though never preferred by English graziers to Scotch cattle, they fatten very rapidly in their own humid climate, and on their own rich plains, especially on the surpassingly fine pastures of Meath, Roscommon, and Limerick. "It is perhaps owing to fast feeding," says Mr. Dickson, "that the grain of the flesh is larger, and it is this property which makes the meat take so well at Liverpool for the shipping. Many are also sent fat to the Glasgow market, where the heavy parts, such as shoulders and rounds, are salted for hams, that city having long been famed for beef hams. The hides of these cattle, on account of their thickness, give from ten to twenty shillings a-piece more than the hides of short-horns of the same weight. Upon the whole, they are a useful breed of cattle, but they have not the fine quality of the Scottish Galloways or the West Highlanders, which take so readily in London. But the Irish cattle can be brought to great weights. I saw a lot in Dublin market of five-year olds, which were estimated in weight 110 stones each, and were sold for £32 a-piece."

The English long-horns have, from the earliest recorded period, existed, as a distinct and peculiar breed, in the district of Craven,—a part of the West Riding of Yorkshire adjacent to Lan-

cashire, and separated from Westmoreland principally by the western moorlands. Droves of Irish cattle have, from time immemorial, been landed in Galloway and in the north of England, and driven through Westmoreland and Lancashire toward the southern counties, there to supply the markets of London and other large towns; and some of these, arrested during their progress southward, seem to have constituted the origin of the long-horns of Craven, Lancashire, and Westmoreland. The Craven group appear to have become settled before the groups of the two adjacent counties; they, at a subsequent period, obtained the distinction of being broader in the chine, shorter in the body, more symmetrical in form, and more rapid in fattening than the Lancashire and Westmoreland long-horns; and they have been pretty generally regarded as the best crossing source for effecting improvements on all other groups of long-horns, whether in Ireland or in England. The long-horns spread from their original settlements into most of the inland districts of England; and, in a more or less modified condition, as well as with a greater or less degree of predominance, became the adopted cattle of Derbyshire, Cheshire, Nottinghamshire, Leicestershire, Rutlandshire, Cambridgeshire, Huntingdonshire, Northamptonshire, Bedfordshire, Buckinghamshire, Staffordshire, Warwickshire, Shropshire, Worcestershire, Oxfordshire, Berkshire, Wiltshire, and Hampshire; yet, formerly over a great extent of these counties, they were both intermixed and crossed with the middle-horns; and at present over an additional extent, they have become superseded by the short-horns.

The long-horns of England, like those of Ireland, are readily discernible from all other breeds by the disproportionate length and sometimes encumbering form of their horns. In the old Craven breed, the horns projected almost horizontally; but in the offspring and improved varieties, they either grew perpendicularly down so as to render grazing difficult, or made such curvatures as to threaten to meet before the muzzle, or swept so round as to threaten to lock the under jaw, or turned their points so inward upon the nose or other parts of the face as to seem to be about to pierce them. Most of the present English long-horns have long, spreading, and sometimes drooping horns; a dark red and brindled colour, with white along the back; good coats of hair; rather coarse bones; fair symmetry; a good adjustment of beef along the back; a capacity of attaining great weight; and a habit of both sound and somewhat rapid feeding. But even the Craven group, like the whole of the Irish long-horns, though with no such wide difference of value, are divisible into two great and very distinct sections. The smaller Cravens inhabit the moorlands and hills; are hardy and easily kept; yield a large produce of excellent milk; have a capacity of rapid fattening when

removed to good pastures; and are much and justly prized by cottiers and small farmers. The larger Cravens inhabit the low and level districts; and yield less milk in proportion to their size and food than the smaller Cravens; but possess an extraordinary tendency to fatten rapidly and to acquire a great bulk and weight. "As either of these found their way to other districts," remarks Mr. Youatt, "they mingled to a greater or less degree with the native cattle, or they felt the influence of change of climate and soil, and gradually adapted themselves to their new situation; and each assumed a peculiarity of form which characterized it as belonging to a certain district, and rendered it valuable and almost perfect there. The Cheshire, the Derbyshire, the Nottinghamshire, the Staffordshire, the Oxfordshire, and the Wiltshire cattle were all essentially long-horns; but each had its distinguishing feature, which seemed best to fit it for its situation, and the purposes for which it was bred. Having assumed a decided character, varying only with peculiar local circumstances, the old long-horns, like the Devons, the Herefords, and the Scotch, continued nearly the same." The long-horns were cherished in preference to all other breeds, and maintained to be the best, by the celebrated improver, Mr. Bakewell; but they are now generally admitted to be decidedly inferior in aggregate worth to the short-horns, and not equal for the shambles to any one of several of the Scotch breeds.

Wild Cattle of Chillingham Park.—The following account of the wild cattle kept at Chillingham, and which are supposed to be the descendants of a species which formerly inhabited this country, is extracted from a letter addressed by Lord Tankerville to Mr. Hindmarsh, who read a paper on these animals at the recent meeting of the British Association. His lordship supposes that "they were the ancient breed of the island, enclosed long since within the boundary of the park," but states that he is not in possession of any documents respecting them, or the period at which the park was first enclosed. "They have pre-eminently all the characteristics of wild animals, with some peculiarities that are sometimes very curious and amusing. They hide their young, feed in the night, basking or sleeping during the day; they are fierce when pressed, but, generally speaking, very timorous, moving off on the appearance of any one, even at a great distance. Yet this varies very much in different seasons of the year, according to the manner in which they are approached. In summer, I have been for several weeks at a time without getting a sight of them; they, on the slightest appearance of any one, retiring into a wood, which serves them as a sanctuary. On the other hand, in winter, when coming down for food into the inner park, and being in contact with the people, they will let you almost come among them, particularly if on horseback. But then they have

also a thousand peculiarities. They will be feeding sometimes quietly, when, if any one appear suddenly near them, particularly coming down the wind, they will be struck with a sudden panic, and gallop off, running one after another, and never stopping till they get into their sanctuary. It is observable of them as of red deer, that they have a peculiar faculty of taking advantage of the irregularities of the ground, so that, on being disturbed they may traverse the whole park, and yet you hardly get a sight of them. Their usual mode of retreat is to get up slowly, set off in a walk, then a trot, and seldom begin to gallop till they have put the ground between you and them in the manner that I have described. In form they are beautifully shaped, short legs, straight back, horns of a very fine texture, thin skin, so that some of the bulls appear of a cream colour; and they have a cry more like that of a wild beast than that of ordinary cattle. With all the marks of high breeding they have also some of its defects. They are bad breeders, and are much subject to the *rush*, a complaint common to animals bred in and in, which is unquestionably the case with these as long as we have any account of them. When they come down into the lower part of the park, which they do at stated hours, they move like a regiment of cavalry in single files, the bulls leading the van, as in retreat it is the bulls that bring up the rear. Lord Ossulston was witness to a curious way in which they took possession, as it were, of a new pasture recently opened to them. It was in the evening about sunset; they began by lining the front of a small wood, which seemed quite alive with them, when all of a sudden they made a dash forward altogether in a line, and charging close by him across the plain, they then spread out, and after a little time began feeding. Of their tenacity of life, the following is an instance. An old bull being to be killed, one of the keepers had proceeded to separate him from the rest of the herd, which were feeding in the outer park. This the bull resenting, and having been frustrated in several attempts to join them by the keeper's interposing (the latter doing it incautiously), the bull made a rush at him and got him down; he then tossed him three several times, and afterwards knelt down upon him and broke several of his ribs. There being no other person present but a boy, the only assistance that could be given him was by letting loose a deer-hound belonging to Lord Ossulston, who immediately attacked the bull, and by biting his heels drew him off the man, and eventually saved his life. The bull, however, never left the keeper, but kept continually watching and returning to him, giving him a toss from time to time. In this state of things, and while the dog, with singular sagacity and courage, was holding the bull at bay, a messenger came up to the castle, when all the gentlemen came out with their rifles, and commenced a fire upon the bull, principally by a steady good marksman, from be-

hind a fence at the distance of twenty-five yards; but it was not till six or seven balls had actually entered the head of the animal, one of them passing in at the eye, that he at last fell. During the whole time he never flinched nor changed his ground, merely shaking his head as he received the several shots. Many more stories might be told of hair-breadth escapes, accidents of sundry kinds, and an endless variety of peculiar habits observable in these animals, as more or less in all animals existing in a wild state; but I think I have recapitulated all that my memory suggests to me as most deserving of notice."—*Reports of the Board of Agriculture.—Marshall's County Reports.—Transactions of the Highland Society.—The Farmer's Magazine.—The Journal of the Royal Agricultural Society of England.—Papers of Mr. Dickson and other writers in Quarterly Journal of Agriculture.—Rev. Mr. Berry's Account of the Short-Horns.—Culley on Live Stock.—Youatt on Cattle.—Sir John Sinclair's General Report of Scotland.—Buel's Farmer's Instructor.—Mortimer's Husbandry.—Martin Doyle's Works.—Dickson's Agriculture.—Low's Agriculture.*

CATTLEYA. A genus of very splendid epiphytous, stove plants, of the orchis tribe. The earliest species known in Britain, was introduced in 1815; and ten other species were introduced before the close of 1837. The genus was named in honour of W. Cattley, Esq., of Barnet in Herefordshire, an enthusiastic patron of botany, and a member of the London Horticultural Society. Some of the species differ widely from others in foliage, size of flowers, habits of flowering, and other characters; so that the genus is likely, at some future period, to be divided into several genera. Some flower early in the season, or take a rest between the bulbing and the flowering; and others flower later, or make one continuous growth from the forming of the bulb till the completion of the flower; and the former of these classes have, in their native country, a double season or a second or returning rain, while the latter have only a single rainy season.

Loddige's species, *C. Loddigesii*, is a native of South America, and was the first species brought to Britain. It has elongated pseudo-bulbs, two leaves, and an exquisitely delicate violet coloured flower; and it grows to about a foot in length, flowers from August till October, and seldom makes more than one pseudo-bulb in the season. The lip of the flower is curved downward, and the sepals and petals are bent backward, so as to render the entire form of the flower remarkably handsome.—Forbes's species, *C. Forbesii*, was introduced from Brazil in 1823. It also has elongated pseudo-bulbs and two leaves; and its flowers are straw-coloured, with a mixture of white on the lip. It usually begins to flower in March; it continues to grow and flower till October; and it then sinks into repose.—The spotted-flowered species, *C. guttata*, was introduced from Brazil in 1827. It agrees in the character of bulb and

leaf with the two preceding species; and usually attains a length of about a foot, and blooms in autumn. The lip of its flower is pinkish yellow colour, mixed with white; and the sepals and petals are greenish yellow, spotted with dark brown.—Skinner's species, *C. Skinneri*, was introduced from Guatemala in 1836. It is one of the most splendid of the two-leaved species; and usually attains a length of about 20 inches. One variety of it has light pink flowers, and another dark pink; but both are exceedingly handsome. Its flower has a very small column, almost concealed by the rolling round of the lip; and it considerably resembles a flower of *Tricopelia tortalis*.—The two-coloured species, *C. bicolor*, has a height of only about 4 or 5 inches, and carries a single flower which is nearly as large as all the rest of the plant. *C. odoratissima*, has large, rich-coloured, agreeably fragrant flowers, and otherwise resembles Loddige's species. *C. crispa* has a single leaf, thick, short pseudo-bulbs, whitish pink sepals and petals, and crisped and crimson-marked flower-lip. *C. Perinii* and *C. citrina* have a very close resemblance to the genus *Lelia*; and the former is very splendid. *C. labiata*, introduced from South America in 1818, is pronounced by Mr. P. N. Don the most noble and graceful of all the species that, up to 1840, had flowered in Britain. "It has the largest flowers," says he, "and at the same time the richest colours. The petals are an exceedingly delicate pink; the sepals brighter; and the lip, which is large, is of the richest crimson; with several intermediate colours, which give it a noble appearance. But it is impossible to convey in words any idea of the beauty of this flower, which is equally rich and delicate." But an unIntroduced species called *C. gigantea* is described as far excelling even this brilliant favourite of Mr. Don.

CATWHIN. See ROSE.

CAUCALIS. See BUR PARSLEY.

CAUDEX. The trunk of a tree. See the article TREE.

CAUL. See COWL.

CAULIFLOWER.—botanically *Brassica Oleracea Botrytis Cauliflora*. A subvariety of the cabbage species. See the articles BRASSICA and CABBAGE. A cauliflower plant is so nearly allied to broccoli as to be nearly undistinguishable from it by an unpractised eye; but it so greatly differs from any of the borecoles, savoy, or true cabbages, as to seem to superficial observers to be connected with them only by arbitrary and useless classification. The leaves of a cauliflower, even when quite young, are readily distinguishable by the uninitiated from those of a cabbage; and the flower-stems and fructification produce a broad, compact, esculent head of white flower-buds, while those of the cabbage rise into a many-branched spike of mutually detached and quite inedible flowers. "The common cabbage puts out one upright stem, from the centre of the cabbage, which afterwards divides into several

branches, whereas the cauliflower sends out many flower-stems from the part eaten; which is only a compact collection of the heads of these stalks, which afterwards divides into so many stems, which also branch out into many spreading shoots, these forming a large spreading head when in flower, but never rising pyramidically like the cabbage." The large, close, firm head or cluster of white flower-buds, and not the leaves, is the part of the cauliflower eaten; it constitutes a delicate esculent which almost every palate relishes; and it is well known to have been jocosely pronounced by the great English lexicographer "the finest flower of the English garden."

Only two varieties of cauliflower are in cultivation,—the early, for the first crops of the year, and the late, for the general or main crops. Heads are obtained for use from May till December, but are in the finest condition in June and July. Both varieties are raised from seeds, and have a half-tender habit, and require to be transplanted. Two, three, or four sowings may be made from early spring till the end of summer; and a sowing, to stand over winter, must be made in August. The soil, preparation, and general culture—excepting in so far as the last requires to be modified by the greater tenderness of the plant—are the same as for broccoli. See the article BROCCOLI.

The first sowing of the year may be made, on a warm border, or on a slight hotbed, at the end of January or early in February; the seed-bed of this sowing must constantly enjoy the protection of a frame; the seedlings may, in March, be pricked out into a similar situation to the seed-bed; and the young plants may, in April and the early part of May, be transplanted to the open ground, some to be gently forced under hand-glasses to succeed the winter-standing crop, and others to advance naturally to maturity in order to succeed those under the hand-glasses. Another sowing may be made, on a warm border, late in March or early in April; the seed-bed, if the weather be severe, must enjoy some protection; the seedlings may, in May, be pricked out into the thoroughly-open ground; and the young plants may, in June, be finally transplanted to succeed the latest of the May transplantation. A third sowing may be made at the end of May, for pricking out in the end of June, and transplanting in the end of July. These sowings may be so regulated, in the pricking out, transplanting, and culture, as to afford a constant succession for use, from the consumption of the winter-standing crop till the beginning of November, or in mild, open seasons, till the approach of January; or a greater number of sowings may be made, at any desired intervals from the end of January till the last week of May.

The seed of all these sowings ought to be dispersed broadcast, and covered to the depth of half an inch with fine mould. Both after sowing

and after pricking out, if the weather be dry water must be given. The seedlings are fit to be pricked out when each obtains four or five leaves about an inch broad; and they ought to be planted at distances from one another of three or four inches. The young plants, when finally transplanted, should be placed at distances from one another of thirty inches, in ground finely pulverized, rich in manurial intermixture, and perfectly open from the shade of trees or fences; and in their after-culture, the soil around them should be frequently stirred with the hoe, and a portion of it drawn up about their stems; and if the weather be droughty, a circular hollow should be scooped out around each, and filled with water twice a-week till they begin to flower, and every alternate day during the progress of their inflorescence. The heads of flower-buds, when fully or nearly formed, may be kept of a pure white colour, and repressed in their tendency to run to seed, by shading them from the sun with overfoldings of the leaves of their own plants.

Various methods have, with more or less success, been tried for preserving matured heads of the last open-ground sowing, through some part of winter, and even till so advanced a period as the latter part of April, so as to continue the supply of cauliflowers for the table to within two or three weeks of the complete circle of the year. A writer in the *Gardener's Magazine*, who seems to have been very successful, says, "Towards the end of autumn, I make a bed or beds, according to circumstances, of moist sand, in any cool house that will exclude the frost. The beds should be four inches deep. Having previously planted a greater number of cauliflower plants than would be required at the time they are to come into use, I take the surplus, when in a good condition, and cut off their roots, leaving a stalk about three or four inches long; I then cut off all the leaves, except the innermost row, and, after shortening these, I insert the stalk into the sandbed, and cover the cauliflower with a flower-pot. In this manner, a large quantity may be contained in a small space; for example, a bed twelve feet square will hold 288 heads. Again, by taking those plants that are not in flower when the frost sets in, and preserving them, in a growing state, in any house or shed where light is admitted, and which will preserve them from a severe frost, these will come into use about the month of January; and, by cutting them, and putting them in the sandbed, they will continue fit for use till the spring. In this way, I have kept cauliflowers to the end of April. It will be necessary, from time to time, to examine and cut off any decayed part that may appear."

The crop of cauliflowers to stand over winter, and come into use in May, must be sown about the middle of August. The seed-bed may be an old cucumber bed, or any other old hot-bed, or a six-inch stratum of light rich mould, upon a six-inch, firmly-trodden stratum of thor

oughly rotten dung; and must be protected with a frame or glasses. The seed must be deposited at the depth of a quarter of an inch; water, if requisite, must be given; and protection from hot sunshine must be afforded by a mat-shading. In the latter part of September, the seedlings, if their leaves be an inch broad, must be pricked out into a similar situation and with similar protection to the seedbed; at the end of October or beginning of November, the strongest of the plants may be transplanted in little clusters under handglasses; and in the end of February or the beginning of March, others may be transplanted from the frames to the handglasses, and the strongest under the handglasses may be placed in the open ground, with protection simply from a south wall or from mats, two plants being left under each handglass; and about the end of April, or the beginning of May, all protection of even the most tender and backward may cease. All transplantings, and specially those to the open ground, must be carefully and cautiously effected, without damage to the roots, and with as large a quantity as possible of adhering soil; all the plants, in the various stages and situations of their growth, ought to have no more protection than is merely sufficient to prevent damage from cold,—the least protected plants being always healthier, and producing larger heads, than those which are much protected; and the plants beneath handglasses should have soil drawn up about their stems, and should be kept uncovered during the daytime of all comparatively mild weather, and, when they ascend to the top of the glasses, should be encircled with a zone of soil four or five inches high, impenetrable to the frost, and forming a basis on which the glasses may rest so as to afford ample space for further growth. The best seed is obtained from select plants of the winter-standing crop.

CAULIS. The culm of a grass, the stem of an herb, or the trunk of a tree. A caulis is defined by Jungius to be the part of a plant which rises single above the earth, and from which the leaves or little branches put forth; and by Miller to be "the upper part of a plant stretched forth to an height, so that the fore parts differ not from the hind, nor the right from the left." A frequent specific name in modern botanical nomenclature is *acaulis*, denoting the species so designated to be stemless; and a common comprehensive name in old botanical language was *cauliferous*, denoting all such plants as have true stems. The name *cauliflower*, botanically *cauliflora*, signifies 'flowering-stem.'

CAUSTIC. A substance which corrodes, burns, or otherwise destroys any exterior part of the animal frame to which it is applied. The most powerful caustic, though rather improperly termed one, is the cautery or red-hot iron. Some of the stronger caustics, in the proper sense of the word, are soda, potash, nitrous acid, and vitriol; and some of the milder are red precipitate, sul-

phate of copper, verdigris, and burnt alum. The most convenient solid caustic is nitrate of silver, in the form of mimic cylinders, and under the well-known popular name of lunar caustic.—The milder caustics are useful in bringing obstinate ulcers into a healing condition; and the stronger caustics are employed to destroy fungous flesh, and other irretrievably diseased portions of the body. The nitric acid in lunar caustic appears to be the agent in destroying the animal texture; and a black stain which results from the application of this substance, seems to be occasioned by the separation of oxide of silver. Lunar caustic is the basis of indelible ink for marking linen, and is sometimes used for giving a black colour to red or grey hair.

CAUTERY. A searing iron which farriers use red-hot, or rather white-hot, for destroying fungous flesh and other irretrievably diseased exterior parts of animal texture.

CAWL, or OMENTUM. A broad and fatty membrane of sheep, cattle, and horses. It is formed from the peritoneum, particularly from those portions of it which are reflected from the paunch. In cattle, it covers the four stomachs and part of the intestines, and seems to support the latter, and to protect them from being injured by the various motions of the body; but in horses, it is comparatively short, extending only to the pancreas and a small part of the colon,—and its apparent use is not so obvious as in cattle.

CAYENNE PEPPER. See *CAPSICUM*.

CEANOTHUS. A genus of ornamental plants, chiefly shrubs and small trees, of the buckthorn tribe. Seven species now comprised in this genus formerly belonged to the buckthorn genus, and one to the staff-tree genus; and six species formerly classed among the *ceanothi* are now assigned to other genera. About twenty species of *ceanothi*, according to the present constitution of the genus, are cultivated in the gardens of Great Britain; and nearly twenty more have been described by botanists. More than one half of the introduced species are evergreen shrubs of from 3 to 15 feet in height, from countries within or near the tropics; one, *C. perennis*, is a hardy, perennial rooted herb, of two feet in height, from Carolina; and most of the others are hardy, deciduous, white-flowered shrubs, of two or three feet in height, from North America. The species distinctively called American, *C. americana*, was introduced from North America in 1713, and is very generally known as a hardy ornamental shrub. It popularly bears the names of red-wood, red-twig, and New Jersey tea. Its stem has a pale brown colour, and a height of between two and three feet; its branches grow from the lower and the middle as well as the upper parts of the stem, and are thin, flexible, and reddish; its leaves stand on reddish footstalks of about $2\frac{1}{2}$ inches in length, and are oval, pointed, serrated, $2\frac{1}{2}$ inches long, and proportionally broad; and its flowers have a white colour, and grow in

clusters at the end of almost every twig, and bloom from July till October. The flowers appear almost to cover the shrub, and give it a very beautiful appearance; and the leaves which intermix with their clusters produce a similar effect to sprigs of myrtle in a richly selected bouquet. The fruit is small and brownish, and sometimes ripens its seed in England. This species is propagable from either seeds or layers; and the other species, some from seeds, some from layers, and some from cuttings.—An eminently beautiful species, the dense-flowered, *C. thyrsiflorus*, was introduced so late as 1844. It is nearly or quite hardy, and has evergreen, shining, oval leaves, and large panicles or clusters of light blue flowers. In its native situations, in many parts of America, it attains the height of a small tree, and, during the period of bloom, is densely enveloped with flowers; and in Britain also, so far as it has yet been tried, it manifests the habit of a very free bloomer.

CECIDOMYIA. See TIPULA.

CEDAR,—botanically *Cedrus*. A small genus of hardy, evergreen, ornamental, timber-trees, of the fir-tree division of the coniferous order. The cedar of Lebanon species, *Cedrus Libani*, formerly called *Pinus cedrus*, is distinguished, by its strong, ramose branches, from all other trees of the same order. The general character of the shoot, even when the tree is young, is singularly bold and picturesque, and quite peculiar to the genus. The tree is a native of the coldest part of the mountains of Libanus, Amanus, and Taurus; but it is not now to be found in those places in great numbers. Maundrell, in his journey from Aleppo to Jerusalem, in 1696, could reckon only sixteen large trees, though many small ones. The forest of Libanus seems never to have recovered from the havoc made by Solomon's forty score thousand hewers. This tree was introduced to Britain from the Levant in the eighth decad of the 17th century, and has ever since been justly regarded as one of the noblest and most imposing ornaments of our parks and home-views. Yet it is so massive and mighty a feature in near grouping as to require to have its situation chosen, if not by a practised landscape gardener, at least by a person of refined and comprehensive taste. The pre-eminent value of its timber, too, is matter, not only of general modern notoriety, but of both civil and sacred history. "This timber, to adopt the words of Hanbury, "was greatly used in the building of Solomon's Temple, which at once convinces us of its superlative excellence. It is said to continue sound for two thousand years; and we are told that, in the temple of Apollo at Utica, there was found cedar wood of that age. The magnificent temples of the Pagans, as well as those of the true God, were chiefly built of this famous timber. The statue of the great goddess at Ephesus was made of this material; and if this tree abounded with us in great plenty, it might have a principal share in

our most superb edifices. The effluvia constantly emitted from its wood are said to purify the air, and make rooms wholesome. It is not obnoxious to worms; and emits an oil which will preserve cloth or books from worms or corruption. The sawdust will preserve human bodies from putrefaction, and is therefore said to be plentifully used in the rites of embalming, where practised." The cedar of Lebanon is propagated from its cones, and will grow well in almost any kind of soil or situation; but, after being planted out from the nursery-bed, it ought never to be touched by knife, hatchet, or other tool, and, with the exception of being fenced from cattle, should be let as completely alone as if it grew in the sublime solitudes of its native clime. A successful attempt was made upwards of 20 years ago, at Nantes in the west of France, to graft the cedar of Lebanon upon the larch.

The deodara or Himalayan cedar, *Cedrus deodara*, was introduced to Britain from Nepal in 1822, and has already become extensively diffused in shrubberies and select collections of ornamental trees. It naturally grows on the stupendous mountains of India and Nepal, at altitudes of from 7,000 to 12,000 feet above the level of the sea; and in aggregate height and character, it is grander on these mountains than even the old cedar on the heights of Lebanon,—very commonly attaining a height of 90 or 100 feet and a girth of upwards of 30 feet. "When young," says Thornton, "it closely resembles the real cedar, but never sends forth spreading branches. The cone resembles that of the cedar, and is preceded by a catkin of a bright yellow colour; so that the tree, when in full blossom, appears covered with a rich mantle of gold. These catkins are loaded with a golden dust, which the wind shakes from the branches in such quantities, that the ground for a considerable distance about the tree becomes, as it were, sheeted with gold. So durable is its timber, that some used in the building of one of the wooden bridges over the Jailum was found little decayed after exposure to the weather for above 400 years." Young plants of the deodara cedar look nearly as well as plants of the exquisitely elegant *Auracaria excelsa*; and they have the great additional recommendation of being unfastidious and hardy; so that they are well adapted for almost every kind of shrubbery.—Two species of cypress, the arbor-vitæ-like and the Portugal, are sometimes popularly called respectively the white cedar, and the cedar of Goa; and seven species of juniper-trees and shrubs, *Juniperi oxycedrus*, *Virginiana*, *Bermudiana*, *Barbadensis*, *thurifera*, *Lycia*, and *Phœnicia*, are sometimes, though with little propriety, popularly called respectively sharp cedar, Virginian or red cedar, Bermudan cedar, Barbadoes or Jamaica cedar, Spanish cedar, Lycian cedar, and Phœnician cedar. See the articles CYPRESS, JUNIPER, and ABIES.

CEDRELA. See BASTARD CEDAR.

CEIBA. See SILK COTTON TREE.

CELANDINE,—botanically *Chelidonium*. A small genus of herbaceous plants, of the poppy tribe. The common species, *Chelidonium majus*, is a perennial-rooted weed of thickets, waste lands, shady banks, and other similar places of Great Britain. Its stem is round, green, and about two feet high; its leaves are large, long, yellowish-green, and deeply divided, and are produced in pairs at each joint of the stem; and its flowers are small and yellow, and grow in little groups upon long footstalks, and bloom from April till October. The whole plant is brittle, and yields, on pressure, an acrid, orange-coloured, medicinal juice. Two hardy, perennial-rooted, yellow-flowered species, from respectively Dauria and the South of Europe, are sometimes cultivated as ornamental plants in gardens.—The frutescent species of bocconia, a stove, evergreen shrub, of ten feet high, from the West Indies, is popularly called the frutescent celandine.

CELASTRUS,—popularly *Staff-Tree*. A genus of ornamental plants, principally evergreen shrubs, forming the type of the natural order Celastrineæ. This order is nearly allied to the buckthorn tribe; yet is readily distinguishable from it by the imbrication of its sepals, and by the alternation of its stamens with its petals. It comprises 18 genera, and has within the gardens of Great Britain about 120 species; and all of these are shrubs or small trees with white or greenish inconspicuous flowers, and, for the most part, simple, alternate, or opposite leaves. Four of the best known and most ornamental genera are celastrus, staphylea, euonymus, and ilex; and one subdivision of the order, comprising two species, takes staphylea for its type,—another, comprising eight species, takes euonymus, and includes celastrus,—and a third, also comprising eight species, takes ilex.

Nearly thirty species of the genus celastrus have been introduced to Britain; and about sixty other species have been scientifically described. The blistered species, *C. bullatus*, was introduced from Virginia in 1759. It is a hardy, deciduous climber, of from 4 to 20 feet in height; several stems rise from each root-stock; and are covered with a brownish bark, and ramify into numerous branches; the leaves grow alternately on the branches, and have an oval, unserrated outline, and a fine green colour; and the flowers are white, and bloom in July.—The climbing species, *C. scandens*, was introduced from North America upwards of a century ago; and is also a hardy, deciduous, and very handsome climber. Its stems are woody and twining, and rise, with the aid of neighbouring shrubs or trees, to the height of 12 or 15 feet; its leaves are oblong, serrated, and pleasantly green, and grow alternately on the branches; its flowers have a greenish colour, and are produced in small bunches from the sides of the branches, and appear in May and June; and its fruit are beautiful, red, roundish, three-cornered capsules, similar to

those of the spindle-tree, and ripen in autumn, and appear in great profusion, and with exquisite ornamental effect, on the tops of the shrubs and small trees which assist the plant to climb.—The spotted and the nodding species are evergreen climbers from Japan and India; the shining species is an evergreen undershrub of two feet in height, from the Cape of Good Hope; the myrtle-leaved species is an evergreen tree of 20 feet in height from Jamaica; and all the other introduced species are evergreen shrubs, of from 3 to 10 feet in height, principally from the Cape of Good Hope, but in five instances from tropical America, the Canaries, and the south of Europe.

CELERIAC. See CELERY.

CELERY,—botanically *Apium graveolens*. A biennial herb, of the parsley genus, and umbelliferous order. It grows wild as a weed in Britain, under the popular name of smallage; and it is cultivated as an esculent in our gardens, under the well-known names of celeriac and celery; but the weed differs very widely, in at once appearance, characters, and properties, from the cultivated plant. Wild celery grows in ditches and marshy situations, particularly near the sea; its root is tapering; its stem is smooth and tubular; its leaves are acrid, disagreeably flavoured, and far from wholesome; its flowers are small, numerous, and greenish-white, and appear in August and September; and its seeds possess the same kind of acrid and unwholesome properties as the leaves. But the stems of the cultivated plant are solid and fleshy; and both these and the leaves, when duly blanched by culture, as well as the seeds in their ordinary condition, possess an agreeable aromatic flavour, and very generally recommend themselves to the human palate. Five principal varieties are in cultivation,—the common, upright Italian, for the main crop, the solid-stemmed upright, the red-stemmed upright, the large red-stemmed upright, and the turnip-rooted, spreading, or celeriac. The last of these is the hardest, and swells at the bottom like a turnip, and differs so widely from the other varieties in characters and habit as to have been frequently regarded as a separate species.

The blanched leaf-stalks of cultivated celery are eaten raw as a salad, and are in season from July or August till March. They are used also to flavour soups, and are sometimes boiled as a dinner vegetable. In Italy, the unblanched leaves are used in soups; and both there and in England, the seeds are employed to flavour soups. Only the root of the celeriac variety is used. "This," says Sabine, "is excellent in soups, in which, whether white or brown, slices of it are used as ingredients, and readily impart their flavour. With the Germans it is also a common salad; for which the roots are prepared by boiling, until a fork will pass easily through them; after they are boiled and become cold, they are eaten with oil and vinegar. They are also sometimes served up at table, stewed with rich sauces.

In all cases, before they are boiled, the fibres of the roots, which are very strong, are cut away; and the root is put in cold water on the fire, not in water previously boiled."

The soil suitable for the cultivation of celery, requires to be rich, moist, and friable, in a situation quite unshaded by trees or fences; it ought either to be exuberant with manurial matter, from excess or remains of manuring through a series of preceding years, or directly manured, not with rank dung, but with vegetable compost; and it must be deeply trenched, made thoroughly porous, freed from stones, and worked into intimate commixation of its manurial with its earthy ingredients. "As in its native state," remarks Mr. Towers, "celery is found in moist places, it is very probable that, in the general mode of culture, it does not receive one half of the water which it requires. I have not witnessed the practice of floating; but it would be well worth while to compare the results of two trenches in the same soil and aspect, one being floated to saturation during dry weather, the other treated in the ordinary manner. I would suggest that an ounce or two of common salt be dissolved in three gallons of soft water, and poured in the watered trench twice a-week. It has been said above, that celery affects spots near the sea; therefore salt may be useful to it. I employ salt continually in the garden, and, I believe, with good effect."

All the varieties of celery are raised from seed. Half an ounce of the seed of any of the upright varieties is sufficient for a bed ten feet long, and four feet and a half broad. The seed must be very lightly buried, either by moderately raking it in, or by covering it with fine earth. Sowings may be made at different periods, so as to afford a succession for use throughout the longest possible period of the year. A first sowing may be made, in March, on a slender hotbed or on a warm border; a second sowing, for main crops, may be made in the end of March or the beginning of April, in an open bed; and a third sowing may be made in the end of April or the beginning of May. The seedlings of all the sowings must be transplanted; and they ought to be removed in such succession, according to their strength, as to afford a regular or unfluctuating series of matured plants for use. When those of the first sowing attain the height of two or three inches, some of the best may be pricked out, and set in nursery-beds, to acquire strength. A few of the earliest, in order to be gently forced, may be planted, at two or three inches distance from one another, on a moderate hotbed; others may be planted in open-ground beds of four feet wide, in rows six inches asunder, and at distances of three inches from one another in the row; and those remaining in the seedbed will grow more strongly on account of being thinned, and may either, at two or three successive times, be pricked out into beds, or allowed to acquire

strength where they are, and transplanted directly into trenches. All the seedlings pricked out into beds must receive water in their new situation, and must be permitted to remain there during about six weeks before their final transplantation.

At successional periods of every two or three weeks, from June till October, plants of from six to twelve inches in height, must be transplanted into trenches. An open compartment of rich ground should be selected for the trenches, cleared from weeds, and marked out, with the line and the spade, into pieces three or four feet asunder, and each a foot in width. Each piece should be scooped into a cavity of the depth of a middle-sized spade; the soil removed from it should be laid, to the right and the left, on the wide spaces between the trenches, and there made even; and the bottom of the trench should be lightly dug, —or, if it have poor soil, it should first be overspread with some rotten dung, and then dug. The plants selected for transplantation should have their straggling tops and long roots trimmed; and should be planted, by dibble, in a single row, along the middle of the bottom of each trench, at distances from one another of four or five inches. Water should be copiously given immediately after the transplanting; and if the weather be dry, it should be occasionally repeated till all the plants fully strike root. The principal after-culture consists in successive earthing-up of the plants, every week, fortnight, or three weeks, till, in technical phrase, they become completely "landed." The first earthing up must be done when the plants have grown two or three inches in the trenches; and must consist in a gentle accumulation of soil around them, to the height of about three or four inches, according to the several height and strength of the plants. The soil which was thrown out of the trenches should be used in the earliest earthings; and afterwards the soil of the wide spaces between the trenches; the earthings should be continued till they attain a height of from 12 to 24 inches, according to the growth or variety of the plants; and all the winter crops ought to be well landed up, to near their tops, in October or November. Some of the earliest plants will be partially blanched, and may be taken up for use, in the latter part of June and throughout July; but the main crops will not be properly blanched till August, and will be in prime condition in September, and thence till the end of winter. The latest crops for spring use, transplanted in September and October, require trenches of only five or six inches in depth, and may be planted in mere drill trenches, formed in properly dug ground.

Judd recommends a method of culture considerably different from the old and ordinary one which we have detailed. He sows about the middle of January, on very rich ground, in a warm situation; he protects his seed-beds, during

the night, with mats; he pricks out his seedlings into a nursery-bed when they are between two and three inches high,—taking care to immerse them in water when taken up, and to keep them moist while out of the ground; he allows them to remain in the nursery-bed till they become very strong; and he prepares his trenches by deep and elaborate digging with the spade, and by richly manuring them with thoroughly rotted old dung from spent hotbeds. “I give the ground a second trenching,” says he, “that the dung may the better be incorporated with the mould, and then leave it in as rough a state as possible, till my plants are ready to put out. In the ground thus prepared, I form trenches twenty inches wide, and six inches deep, at six feet distance from each other, measuring from the centre of each trench. Before planting, I reduce the depth of the trenches to three inches, by digging in sufficient dung to fill them up so much. At the time of planting, if the weather be dry, the trenches are well watered in the morning, and the plants are put in, six inches apart in the row, in the evening, care being taken to keep the fibres quite wet whilst out of ground. As they are drawn from the nursery-bed, the plants are dressed for planting, and then laid regularly in the garden-pan. The trenches in which my rows of celery are planted being so very shallow, the roots of the plants grow nearly on a level with the surface of the ground; this I consider particularly advantageous, for as considerable cavities are necessarily formed on each side when the moulding takes place, all injury from stagnant water or excess of moisture is prevented. The trenches, when planted, are watered as may be required. I do not think it well to load the plants with too much mould at first; the two first mouldings, therefore, are done very sparingly, and only with the common draw-hoe, forming a ridge on each side of the row, and leaving the plants in a hollow to receive the full benefit of the rain and waterings. When the plants are strong enough to bear six inches height of mould, the moulding is done with the spade, taking care to leave basis enough to support the mass of mould which will ultimately be used in the ridge, and still keeping for some time the plants in a hollow. The process of moulding is continued through the autumn, gradually diminishing the breadth of the top, until at last it is drawn to as sharp a ridge as possible, to stand the winter. In the operation of moulding, it is necessary, in order to prevent the mould from falling into the heart of the plant, to keep the outer leaves as close as possible. For this purpose, before I begin the moulding, I take long strands of bass matting, tied together till of sufficient length to answer for an entire row, and I fasten this string to the first plant in the row, then pass it to the next plant, giving it one twist round the leaves, and so on till I reach the other end, where it is again fastened. When the moulding is finished, the string is easily unravelled by be-

ginning to untwist it at the end where it was last fastened.”

Celeriac is sown at the same time as the other varieties of celery, but requires a somewhat different treatment. Its seeds cannot always be relied upon; and ought to be carefully selected, and put fully to the test. They should be sown very early in the year on rich soil, on a hotbed, under glass; or in March or April, on beds of ordinary soil. The seedlings of the earliest sowing, may, when two or three inches high, be transplanted into another hotbed, at distances from one another of an inch and a half; and in the beginning or middle of June, the young plants may be transplanted into flat beds in the open ground, at distances from one another of fifteen inches; but they must not, like the other kinds of celery, be transplanted into trenches. Copious watering must be given immediately after the transplanting; it should afterwards be repeated daily in warm weather, and every alternate day in cool weather; and when the plants increase in size, the watering should increase in copiousness, and the hoe should be occasionally used. The roots of a properly cultivated succession are in season from September till January.

CELLS. The small hexagonal divisions of honeycombs; also the cavities or spaces between the partitions of pods, husks, and other seed-vessels.

CELLULAR TISSUE. Animal cellular tissue, substance, or membrane, is the medium which connects and supports all the various parts and structures of the animal body. Any person may gain a general notion of this substance by observing it in joints of veal, when it is inflated by the butchers. It consists of an assemblage of fibres and laminae of animal matter, connected with each other so as to form innumerable cells or small cavities, from which its name of *cellular* is derived. It pervades every part of the animal structure. By joining together the minute fibrils of muscle, tendon or nerve, it forms obvious and visible fibres. It collects these fibres into large fasciculi, and, by joining such fasciculi, or bundles, to each other, constitutes an entire muscle, tendon or nerve. It joins together the individual muscles, and is collected in their intervals. It surrounds each vessel and nerve in the body, often connecting these parts together by a firm kind of capsule, and, in a looser form, joining them to the neighbouring muscles, &c. When condensed into a firm and compact structure, it constitutes the various membranes of the body, which, by long maceration in water, may be resolved into a loose, cellular texture. In the bones, it forms the basis or ground-work of their fabric, a receptacle, in the interstices of which the earth of bone is deposited. As cellular substance is entirely soluble in boiling water, it is considered, by chemists, as that peculiar modification of animal matter termed *gelatine*. In consequence of its solution by the united agencies

of heat and moisture, the muscular fibres separate from each other, and form the other structures of the body. This effect is seen in meat which is subjected to long boiling or stewing for the table, or, indeed, in a joint which is merely over-boiled. It forms a connexion and passage between all parts of the body, however remote in situation or dissimilar in structure; for the cells of this substance everywhere communicate, as we may collect from facts of the most common and familiar occurrence. In emphysema, where air escapes from the lungs wounded by a broken rib into the cellular substance, it spreads rapidly from the chest into the most remote parts of the body, and has even been known to gain admission into the eye-ball. A similar diffusion of this fluid may be effected by artificial inflation.

Vegetable cellular tissue is a soft and succulent aggregation of exceedingly minute cells. It constitutes the whole of the substance of cryptogamous plants, the principal substance of herbaceous phenogamous plants, and a considerable portion of many parts of even shrubs and trees. It abounds in succulent fruits and in seed-lobes; it is prominent in leaves, flowers, petioles, and peduncles; it is conspicuous in the stems, branches, and other parts of all phenogamous non-ligneous plants; and, though not so apparently cellular or succulent as in the preceding instances, and particularly as in cryptogams, it is very distinguishable in the young bark, the twigs, and the central pith of even the most thoroughly ligneous plants. "When viewed without the microscope," remarks Keith, "its appearance is that of an assemblage of small and minute granules imbedded in a soft and glutinous substance, as in the greater part of leaves and succulent fruits. But it is only when viewed minutely, and with a good glass, that its true structure is to be detected. Malpighi describes it with his usual accuracy, and compares it to an assemblage of inflated threads or bladders containing a juice. Grew describes it under the appellation of parenchyma, and compares it to the bubbles formed upon the surface of liquor in a state of fermentation. Duhamel represents it as consisting of a net-work of fibres interspersed with small and granular or bladder-like substances occupying the interstices. Such were the descriptions of the earlier vegetable anatomists. But later anatomists have been more minute. Mirbel describes it as being composed of clusters of small and hexagonal cells containing a juice. This was an important step in advance, as exhibiting a correct view of that modification of figure which is perhaps the most frequent in the composition of cellular tissue. After all, we believe the spheroid to be the original and normal form of all cells; all other forms, such as the square, the prismatic, the oblong, the columnar, being occasioned merely by the compression or extension of the primitive spheroid."

CELLULARES. One of the two grand or pri-

mary divisions of the vegetable kingdom. It is very nearly identical with the Cryptogamia of Linnæus, and the Acotyledonæ of Jussieu; but is preferred to these by later botanists, on account of its expressing a more obvious character. Plants, viewed as cryptogamous, possess a very obscure fructification; the same plants, viewed as acotyledonous, have no proper seeds or seed-lobes; and most of the same plants, viewed as cellular, consist wholly of cellular tissue, to the exclusion of spiral vessels or vascular structure, or do not form woody matter and have no veined leaves. Ferns, however, are naturally included among acotyledons, and excluded from among cellulares; yet, on account of their thoroughly cryptogamous character, they are systematically included among the latter; and they may be truly regarded as constituting the connecting link between the cellulares and the vasculares, or as lying along both sides of the boundary-line between these two great divisions. The fungi and the algæ have no leaves; and, in some instances, make a very near approach to the limits of the animal kingdom.

CELOSIA. See COCKSCOMB.

CELSIA. A genus of yellow-flowered ornamental plants, of the nightshade family. Nine or ten species, natives of the Levant, North Africa, and the East Indies, are cultivated in British gardens. The oriental, the clammy, and the Coromandel species are annuals, the woolly species is an evergreen undershrub, and the other species are biennials. Their height is from two to six feet; and the appearance of their flowers similar to that of alonsoas. The oriental species is the longest and best known, and was brought to Britain in the early part of last century. Many oblong leaves, finely divided on both sides almost to the midrib, grow from the crown of its roots, and lie flat along the ground; a round herbaceous stem arises from among them, grows to the height of about two feet, and is garnished over its whole length with leaves similarly shaped to the root-leaves, but gradually diminishing in size as they ascend the stem; and the flowers are produced at the footstalks of these leaves, over more than one-half of the stem, and are iron coloured without, and pale yellow within, and generally bloom in July and August.

CELTIS. See NETTLE-TREE.

CEMBRA. A group of varieties or sub-species of pines. They are natives of Siberia and Switzerland, and are highly ornamental trees in Britain; but their qualities as timber-trees have not been well ascertained. The principal are the Cembran and the Siberian, each usually about 60 feet high; the Swiss, about 40 feet; and the pigmy, or shrub, about 6 feet. See the article **PINE**.

CEMENT. A paste of various composition applied to unite solid surfaces, by hardening between them, but rarely forming a combination with the constituents of either surface. The

most common of all cements are mortar and hydraulic cements. See MORTAR. In many cements, pulverulent substances are mingled with a glutinous or very adhesive material, and do not combine chemically, in others a chemical combination ensues. Those designed to stop up crevices and joints in apparatus temporarily put together are termed lutes. The following are some of the numerous recipes for cements:—

Lutes.—1. Gypsum cast between paper; it may be mixed with water, or better with milk, glue-water, &c. 2. Dry slacked lime and strong glue-water mixed to a stiff paste; or the same with white of egg is well adapted for porcelain, &c.; it may also be made of lime and blood. This lute will not bear much moisture. 3. Cheese, boiled with a little water, and rubbed to a paste with slacked lime, hardens readily. 4. Clay, iron-filings, and gum mucilage becomes hard and adheres tenaciously. 5. Ground flax-seed made into a stiff paste with water, milk, glue-water, or lime-water, closes perfectly, hardens soon, and resists acids, &c. 6. Boil linseed oil, fuse caoutchouc in it, add pipe-clay, and incorporate them thoroughly; more caoutchouc prevents too rapid hardening; it should be kept in a moist and cool place. It resists acids more or less, and not hardening during distillation, &c., the parts of the apparatus may be moved about without causing openings, or, if it does, the pressure of the finger closes them. 7. Fused caoutchouc alone resists acid vapours, and the temperature of boiling sulphuric acid.

Resinous cements.—1. Any varnish may answer the purpose where a thick layer is not required, for the resinous cements are apt to shrink. 2. Fish-glue is softened in a little water, dissolved in boiling brandy, and mixed with a very concentrated solution of mastic, gum ammonia, &c.; it should be kept in a corked vial, and warmed when used. It cements porcelain, glass, &c., powerfully, and resists moisture to some extent. Keller recommends the following mode of preparing it:—Two parts fish-glue, cut into fine pieces, are left for 24 hours covered with 16 parts water, then boiled down to 8 parts, mixed with 8 parts alcohol, and strained through linen. This liquid is mixed while hot with a solution of 1 part mastic in 9 parts alcohol, and to the whole $\frac{1}{2}$ part gum ammoniac, finely pulverized, added gradually, and the liquid rendered perfectly homogeneous. In using it, both cement and the fragments are made as warm as possible, both pieces allowed to dry, then again rubbed over with the cement, and pressed together. After five or six hours it is perfectly hard. It is not applicable to vessels of porous earthenware; the best cement in this case is a thick solution of shell-lac in spirits of wine. 3. Rosin and wax melted together and mixed with fine brick-dust forms a good cement between brass and glass, as in many kinds of physical apparatus; it is applied melted; 3 to 5 rosin, 1 wax, and 1 brick-dust

(Spanish brown or ochre) are good proportions. Wax and turpentine form a good cement, which, for convenience, may be cast into sticks, and melted off by a hot iron. White wax, white rosin, and a little Canada balsam form a good and nearly colourless cement. 4. As a cement for glass and porcelain, M. Hanle recommends a mixture of 2 parts shell-lac and 1 part turpentine, which are fused together and formed into sticks. This may also be employed for cementing wood, &c., when dissolved in spirit and evaporated to the consistence of a syrup. Hensler grinds 3 parts litharge, 2 parts of recently burnt lime in powder, and 1 part white bole, to a mass with linseed-oil varnish. This cement is very tenacious when allowed to dry sufficiently long.

Fire cements.—1. For furnaces, crucibles, &c. Fire-clay and brick-dust, or fire-clay and burned clay (broken crucibles) kneaded well together with water, and spread in layers on joints, and thoroughly air-dried, resists heat without cracking. It may also be employed for coating glass retorts, by spreading it as a stiff paste or thinning it with water and spreading with a brush. A little hair added to it gives greater tenacity. 2. Clay and brick-dust mixed with water and $\frac{1}{2}$ part borax gives a difficultly fusible cement; clay and red lead may be used. To make it less fusible, common clay and sand may be employed. 3. For iron vessels, &c., mix 50 to 58 parts fine and pounded cast-iron turnings with 2 parts powdered sal-ammoniac and 1 part flowers of sulphur into a paste with water, and apply it immediately; it forms a chemical union, and hardens rapidly. According to some the sulphur may be omitted. 4. Four parts iron filings or turnings and 3 parts of a mixture of common and burned clay are made into a paste with salt water. See also MASTIC and MORTAR.

CENCHRUS. A genus of grasses, of the lolium tribe. The echinated species, *C. echinatus*, is a curious, hothouse biennial, of two feet in height, long ago introduced from the West Indies; the thorn-bearing species, *C. spinifex*, is a curious perennial, of about a foot in height, introduced about 25 years ago, from South America; and the tribulus-like and the southern species, are hardy annuals, of about a foot in height, recently brought from North America and New Holland. Eight or nine other species are known. The word Cenchrus is the Greek name for millet. Several of the species are prickly.

CENTAUREA. A large genus of ornamental plants, of the thistle division of the composite family. Several species are annoying but beautiful weeds of Britain; and not a few are cultivated as ornaments of our gardens. About 160 species exist in Great Britain; and about 25 other species have been scientifically described. Those within Britain have been systematically divided and subdivided so as to constitute a number of very distinct groups.—One group, comprising upwards of a dozen species, have plumose

flowers, and the scales of their calyx pectorately ciliated. One of these, the hyssop-leaved, is a very small, evergreen, Spanish undershrub; and all the others are hardy perennial-rooted herbs. A native species, *C. nigra*, is the common black knapweed of our pastures. This is very abundant and generally diffused; it usually attains a height of about a foot, and blooms from May till August; and it ranks as one of the most stubborn and troublesome weeds of our grass fields. All the species of this group, except one, carry purple-coloured flowers.—Another group, comprising between 20 and 30 species, have for the most part reddish-purple flowers, with green disks, and their calyx fringedly ciliated. One species, the panicked, is a biennial; one, the evergreen, is a tender evergreen herb; one, the cineraria, is a half-tender herb; and all the others are hardy, perennial-rooted herbs. The most interesting to the farmer is the very common and annoying greater knapweed, *C. scabiosa*. See the article Knapweed.—A third group, comprising one biennial, and ten or eleven hardy perennial-rooted herbs, have fringed, scarious calyxes, and, for the most part, yellow flowers.—A fourth group, comprising an annual, two biennials, and about 25 hardy herbaceous perennials, have mucronately-ciliated calyxes.—A fifth group, comprising two biennials, and about a dozen hardy herbaceous perennials, have scarious, sublacerated, ciliate calyxes. One of these, *C. jacea*, is the brown knapweed, so common on our meadowy, clayey pastures. All these five groups agree in having ciliated calyxes, and they may be regarded as aggregately constituting the more proper centaureas, in contradistinction to the crupinæ, the cyani, the crocodilia, the seridia, and the calcitrapæ.

The crupina group, comprising five hardy annuals, and three hardy perennials, have the scales of their calyx entire. One of the annuals, *C. moschata*, is the well-known and very favourite sweet sultan, introduced upwards of two centuries ago from Persia, and almost everywhere cultivated as one of the most handsome of our hardy composite annuals; and one of the perennials, *C. centaurium*, is the great centaur, introduced from Italy before the close of the 16th century, growing 4 feet high, and carrying yellow flowers in July and August.—The cyanus group have for their type the well-known bottle-flower or blue-bottle, and comprise two half-tender evergreen undershrubs, two hardy annuals, and about a dozen hardy herbaceous perennials. Most, like the blue-bottle, have blue flowers; but five, including the two undershrubs, have yellow flowers. The blue-bottle grows wild in our cornfields, yet has long had a place in cottage gardens.—The crocodylium group have entire calyxes, with spinous tops; and three of its species have their tops one-spined, while seven have them mucronately spinulose. Some are annuals, some biennials, and some perennials, all hardy.

—The seridia group have the tops of their calyxes palmately spinous, and comprise about a dozen annuals, four or five biennials, and seven or eight perennials, nearly one-half yellow-flowered, and the others red or purple-flowered. The solstitial species, *C. solstitialis*, is a pretty yellow-flowered annual weed, two feet high, in the fields of England, and is popularly called St. Barnaby's thistle; and Isnard's species, *C. Isnardi*, is a pretty, purple-flowered, perennial weed, 14 or 15 inches high, in the Channel Islands, and is popularly called the Jersey star-thistle.—The calcitrapa group have the scales of their calyx spinosely pinnate, and comprise a half-tender perennial, a hardy biennial, and six or seven hardy annuals. The star-thistle, *C. calcitrapa*, forms the type of the group, and is a well-known, annual, pink-flowered weed, of the gravelly soils of England. See the article STAR-THISTLE. The blessed thistle, *C. benedicta*, is a medicinal plant, and has a place in both the Edinburgh and the Dublin pharmacopœias. It is cultivated, as a hardy annual, in the gardens of Britain; and it grows wild in Spain and the Grecian islands. Its root is whitish, cylindrical, and branched; its stem is erect, roundish, channelled, rough, and about two feet high; and its leaves are long, elliptical, rough, and runcinate. It ought, for medicinal use, to be cut when in flower, dried with rapidity, and preserved in a dry airy place. Its odour is unpleasant but weak; its taste is exceedingly bitter, but comparatively transient; and its virtues, according to the degree in which it is administered, are variously tonic, diaphoretic, and emetic. It anciently acquired the epithet of benedicta or blessed from its extraordinary pharmacœutic powers; but it has lost most of its celebrity, and is now very seldom used.—The species of centaurea most commonly cultivated for ornament are, of hardy annuals, *C. cyanus*, *moschatus*, *suaveolens*, and *adami*; of hardy biennials, *C. splendens*, *romana*, and *salmonatica*; of hardy perennials, *C. glauca*, *alpina*, *phrygia*, *rupestris*, *austriaca*, *pectinata*, *venosa*, *nigra*, *montana*, *pul-lata*, *ovata*, *ovina*, *maculosa*, *coracea*, *stæbe*, and *orientalis*; and of frame perennials, *spinosa*, *sempervirens*, *ægyptica*, and *argentea*.

CENTAURY,—botanically *Erythraa Centaurium*. An indigenous, ornamental, medicinal, annual plant, of the gentian tribe. It is known in Sowerby and Smith's English botany as *Chironia centaurium*, and in many popular writings as *Common centaur*. It grows wild on heaths and on dry gravelly pastures. Its root is small, woody, and branching; its stem is smooth, quadrangular, erect, and from 6 to 12 inches high; its leaves are opposite, sessile, elliptical, and three-nerved; and its flowers are produced from the angles of the division of the stem, expand only in sunshine, have a pink colour, and bloom in July and August. The stem, leaves, and petals possess an intensely bitter taste, and all the tonic, antiseptic and other characteristic

medicinal properties of the officinal gentianæ; and they completely surrender these qualities to either alcohol or water, so as to be exhibitable in the form of either tincture, infusion, or extract. Previous to the use of cinchona, centaury was an ingredient in the celebrated Portland powder, and was much employed in the medical treatment of fever; and it might still be very beneficially used, in lieu of more expensive remedies, in cases of dyspepsy and other complaints of the stomach.

CENTIPEDE, or SCOLOPENDRA. A genus of insects belonging to the order *Myriapoda*. They are distinguished by having antennæ of 14 joints and upwards, a mouth composed of two mandibles, a quadrid lip, two palpi, or small feet, united at their base, and a second lip, formed by a second pair of dilated feet, joined at their origin, and terminated by a strong hook, having an opening beneath its point, through which a poisonous fluid is thrown out. The body is long, depressed, and membranous, each ring being covered by a coriaceous or cartilaginous plate, and mostly having one pair of feet: the last is usually thrown backwards, and elongated in the form of a tail. These insects are nocturnal and carnivorous, and uniformly endeavour to escape from the light. They conceal themselves under the decayed bark of trees, the decayed timbers of buildings, among stones, lumber, and rubbish, whence they sally forth at night in search of prey. The centipede is one of the greatest pests to be encountered in the West India islands, and throughout the hot parts of the American continent. The materials of which the houses are constructed, and the rapid decay to which timber is subject in such climates, afford these noxious insects excellent hiding-places, and they multiply with great rapidity. The utmost vigilance, even in the most cleanly houses, is necessary to prevent these creatures from finding their way into the beds, which they often do notwithstanding all the care that is taken to prevent them. They always attempt to escape when a light is brought into the room. They run with considerable swiftness, but are quite ready to stand on the defensive, and bite with severity. This disposition to bite upon the slightest provocation renders them very dangerous when once they have entered a bed; the least movement of the sleeper over whom they may be crawling, and who can scarcely fail to be disturbed by their sharp-pointed feet or claws acting upon his skin, will insure a venomous bite, which will be frequently repeated if the centipede be not speedily dislodged. The bite is exceedingly painful at the moment, and is followed by a high degree of local inflammation and a fever of great irritation. Where the insect is large, and the bite severe, life is much endangered, and not unfrequently lost, especially if the sufferer be of delicate and irritable habit of body. The immediate application of a cupping-glass, or any convenient substi-

tute, over the wound, removes the pain and danger at once. Spirits of hartshorn (volatile alkali) applied to the part, and doses of the same administered internally (30 or 40 drops) twice, thrice, or oftener in a day, will also lessen the pain, and avert dangerous consequences. The mode of treatment first mentioned is the quickest and most certain. A popular remedy, in all places where the centipede is common, is the application to the wound of brandy or rum in which a centipede has been for some time preserved. This truly noxious insect grows to the size of six inches and more in length, and is a formidable inmate of most of the houses in tropical regions. Bishop Heber speaks of them as being very large and poisonous in different parts of India. So accustomed are the West India slaves and residents to their presence, and regardless of danger from their bite, that no particular pains are taken to lessen their numbers, or to banish them effectually. It is very probable that they might be readily destroyed by placing poisoned food within their reach; yet, while resident in the West Indies, we never heard of any one being at the trouble of the experiment, though centipedes were almost daily killed about the house. Species having considerable resemblance to the centipede of the West Indies, and much dreaded on account of their bite, are often seen about extensive collections of timber and lumber at the saw-mills on the head waters of the Susquehanna, &c. A smaller, dark, reddish-brown species, known by the name of *thousand legs*, is common in most parts of this country, living under dead bark or among decaying timbers. The order *Myriapoda*, to which these insects pertain, from their crustaceous covering, the formation of the mouth, &c., appears to form the transition from the crustaceous or crab-like animals to insects proper. They are the only insects which, in their perfect state, have more than *six* feet, and have the abdomen not distinct from the trunk. They live and grow much longer than other insects, surviving through several generations. When first hatched, they have but six feet, or, at least, fewer than they afterwards acquire. The additional feet, as well as the rings to which they are attached, become developed as they advance in age—a sort of change peculiar to this race.

CENTOTHECA. See BURDOCK.

CENTRANTHUS. A genus of ornamental herbaceous plants, of the valerian tribe. The caltrop-leaved, *C. calcitrapa*, is a purple-flowered annual, of about a foot in height, blooming from May till July, and introduced about 180 years ago, from Portugal. The red species, *C. ruber*, is a perennial-rooted wild plant of the meadows of Britain, growing about 20 inches high, and carrying a crimson-coloured flower from May till July; and a white-flowered variety of it, *C. r. flore-albo*, has long been cultivated in gardens. Two other species are known. The name cen-

tranthus signifies 'spurred-flower,' and alludes to the peculiar shape of the flower.

CEPA. See ONION.

CEPHAELIS. A genus of ornamental tropical plants, of the madder tribe. Eight species have been introduced to the hothouses of Britain; and about twenty others are known to botanists. Six of the introduced species are shrubs of from 3 to 15 feet in height, and the other two are low trailers. The roots of one of the unimported species, *C. ipecacuanha*, furnish the chief or best kinds of the ipecacuanha of the drug-shop. See the article IPECACUANHA.

CEPHALANTHERA. A genus of indigenous orchidaceous plants, erected, by the French botanist Richard, out of the genus epipactis. Three species are known, the pale, the red, and the sword-leaved, the first and the third with white flowers, and the other with purple flowers; and all grow wild in the moist woods of Britain, attain a height of 12 or 15 inches, bloom in June, and have a handsome appearance. The name cephalanthera is compounded of two words which signify 'head' and 'anther.'

CEPHALANTHUS. See BUTTON-WOOD.

CEPHALOTUS. A curious, evergreen, herbaceous, greenhouse plant, of the rosaceous order. It forms a genus of itself, and takes for its specific name *follicularis*. It was brought from Australia in 1822; and is frequently called the pitcher-plant of New Holland. It has white flowers, usually grows to the height of about a foot, and is delicate, and requires a very calm and moist atmosphere. Its natural position is in such shelter among other plants as to enjoy partial shade from sunshine, and constant protection from sudden changes of heat or moisture; and its best artificial position is in a mixture of charcoal, fibrous peat, and finely chopped moss, in a small pot, plunged within a larger pot, and either occasionally under a bell-glass in the greenhouse, or constantly in a cool part of the stove.

CERADIA. A genus of plants of the composite order. Only one species, *C. furcata*, has yet been brought to Britain; and this was quite recently introduced from the famous guano island of Ichaboe. It is nearly related to the fleshy-stemmed shrubs, formerly called cucalias, but now called kleinias. It is a singular and insignificant looking dwarfish shrub; its stems are fleshy, forked, and very much branched; its leaves are succulent, spatulate, and light green; and its flowers are pale yellow, in solitary heads, and so small as to be scarcely visible among the leaves. A gummy substance is exuded from every wound made in its stem, and was at first supposed to be the fragrant African olibanum, but proves on trial to be considerably different from that substance, and quite destitute of fragrance. The plant has received the popular name of the coral bush of Ichaboe.

CERASIN. The gummy substance which ex-

udes from cherry-trees, plum-trees, peach-trees, apricot-trees, and other trees of the genera cerasus, prunus, persica, and armeniaca. When acted on by heat, it becomes identical with gum arabic; and when acted on by nitric acid it yields mucic acid.

CERASTIUM. See MOUSE-EAR CHICKWEED.

CERASUS. A genus of fructiferous and ornamental trees and shrubs of the rosaceous order. Two species, *C. avium* and *C. padus*, grow wild in British woods, and have several varieties in extensive cultivation; about thirty species have been introduced from foreign countries, principally the south of Europe, North America, and the east of Asia; and about a dozen other species have been scientifically described. Six of the species in Britain, including numerous varieties, are cultivated as fruit-trees, under the common name of cherry-trees. Eight, including the bird-cherry, with its varieties, are ornamental deciduous trees of from 15 to 30 feet in height. Ten, the ground-cherry, the peach-leaved, the dwarf, the pigny, the depressed, the wintry, the prostrate, the pubescent, the Japan, and the Chicasaw, are deciduous ornamental shrubs of from one foot to twelve feet in height. Four, the *mahaleb*, the Portugal laurel, the common cherry laurel, and the Carolinian or evergreen bird cherry, are well known hardy, evergreen, ornamental shrubs and trees of from 12 to 30 feet in height. And two, the round-fruited, and the West Indian, are hothouse evergreens, of respectively 10 and 20 feet in height. The whole genus is highly ornamental; and a number of its species engross much of the attention of mercantile nurserymen.—See the articles CHERRY, BIRD-CHERRY, and LAUREL.

CERATE. An unctuous medicinal composition, containing a considerable proportion of wax, taking from this ingredient the name of cerate, and possessing a degree of consistence intermediate between that of a plaster and that of an ointment.

CERATOCHLOA,—popularly *Horn-Grass*. A small genus of grasses, of the fescue tribe. The only species known in Britain is *C. unioloides*; and this is a hardy annual, of about 20 inches in height, and was introduced from North America in 1788.

CERATONIA. See CAROB-TREE.

CERATOPETALUM. A beautiful evergreen tree, of the cunonia tribe. It forms a genus of itself, and takes for its specific name *gummiferum*. It is a native of New Holland, and was introduced to Britain in 1820. It grows to the height of about 50 feet, and has horned petals and yellow flowers. Its economical properties, if it possess any, have not yet been investigated.

CERATOPHYLLUM,—popularly *Hornwort*. A small genus of indigenous aquatic plants, constituting of itself the natural order Ceratophylleæ. Two species, the demersed and the submersed, both perennials of about a foot in height, grow in the ditches of Britain, and flower from July

till September; but they possess little interest, and are nearly akin to water-milfoil.

CERBERA. A genus of ornamental, tropical, evergreen shrubs and trees, of the dog's bane tribe. The Ahouai species, *C. Ahouai*, is a native of Brazil and the West Indies, and was introduced to the hothouses of Britain in 1739. Its stem is irregular, sends out many crooked and rambling branches, and usually attains a height of from 10 to 20 feet; its leaves are thick, succulent, smooth, lucid green, full of milky juice, and about three inches long, and nearly two broad; and its flowers are produced in loose bunches at the ends of the branches, and have a cream-yellow colour, and a shape somewhat like those of oleander, and bloom in June and July. "The wood of this tree," says Miller, "stinks most abominably; and the kernels of the nuts are a most deadly poison, so that the Indians always caution their children against eating them, for they know of no antidote to expel this poison; nor will any of them use the wood for fuel: they take the kernels out of the shells, into which they put small stones, then bore a hole through each shell, and string them; these they tie about their legs to dance with, as the morris-dancers use bells."—The odallam or manghas, *C. odallam*, is a native of India and of some parts of the West Indies, and was brought from the former of these countries to Britain about the middle of last century. Its stem is woody, about 20 feet high, and profusely branched at the top; its leaves are long, spear-shaped, rounded at their ends, thick, succulent, and lucid green; and its flowers have a white colour, and are produced in twos and threes, on long foot-stalks, at the ends of the branches.—The tanghin species, *Cerbera Tanghin*—called by Poiret *Tanghinia veneniflua*, and popularly the Madagascar ordeal-tree—was introduced to Britain from Madagascar in 1826. It usually grows to the height of about 30 feet, and carries pink-coloured flowers in May. The kernels of its fruit are rather larger than almonds, and are so virulently poisonous that one kernel would destroy upwards of twenty persons. The priests of Madagascar, who act also as physicians, administer this poison to accused or suspected persons as an ordeal, in the notion that it will convict the guilty, and clear the innocent. The timber of this species is hard, veined, and fit for cabinet-work and inlaying.—A species introduced to Britain from the Spanish West Indies about the same time as the Ahouai, was popularly known, in Miller's time, as the French physic-nut; the bark of either the Odallam or *Cerbera lactaria* is purgative; the inspissated juice of a species popularly known in Mexico as Ycotli, is a very virulent poison; and the genus in general borrows its name from the mythological dog Cerberus, on the strength of its highly poisonous character. Nine species, of from 3 to 30 feet in height, have been introduced to Britain, and six others are known to botanists.

CERCIS. See JUDAS-TREE.

CEREAL GRASSES. Grasses whose seeds are used as corn. The mythological goddess of corn and harvests, among the pagan Romans, was Ceres; and the festivals held at Rome in her honour were termed Cerealia. The grasses which yield corn, or which were out down in harvest in order that their seeds might be thrashed out and used as food, were hence called cereal grasses, or abbreviatedly cereal grasses. The chief of these at present cultivated, on a large scale, in Europe are wheat, barley, oats, danthonia, rye, and maize; the principal cultivated on a small scale in Europe, are canary-grass and millet; and the principal cultivated, on a large scale, in the southern parts of the temperate zone, and within the tropics, are millet, setaria, sorghum, and rice.

CEREBRUM. See BRAIN.

CERES. See CEREAL GRASSES.

CERESIA. A small genus of grasses, of the spartina tribe, or with terminal spikes. Only one species, *C. elegans*, is known in Britain; and this was introduced in 1816, from Peru. But it has the appearance of an evergreen herb, grows to the height of about two feet, flowers in July and August, and ranks as an ornament of the greenhouse. The name ceresia alludes to the pagan goddess Ceres.

CEREUS. A large and interesting genus of the opuntia or cactus tribe. Upwards of fifty species have been introduced to Great Britain; and probably about a score of other species are known to botanists. The introduced species constitute a very important division of the cactus family, whether for their grotesqueness, their flowers, or their fruit; and, with scarcely an exception, they require to be cultivated in a hot greenhouse. The royal, the polygonal, the repand, and the hexagonal, have usually a height of respectively 10, 10, 20, and 35 feet, and three or four others have a height of 6 or 7 feet; but all the rest vary in height from about 6 inches to 4 feet. A few have a trailing or rambling habit; but most have the erect and compact habit of shrubs or undershrubs. The multangular, the Peruvian, the woolly, the repand, and Royen's, are remarkable principally for their fruit; the noble, the flagelliform, the great-flowering, Colvill's, Napoleon's, the triangular, the showiest, the splendid, the bristled, the crenated, and some hybrids are remarkable for the brilliance and size of their flowers; and all or most of the others are remarkable chiefly for their very curious and grotesque appearance.—The great-flowering, known also as the night-flowering, *C. grandiflorus*, was introduced from Jamaica in 1700; it has a trailing habit, and is usually about a foot in height; and it produces very splendid whitish-yellow flowers, and blooms from June till August. So many as ten of its magnificent flowers are sometimes simultaneously in bloom; and even several series of such blooms

occasionally follow in rapid succession.—The crenated species, *C. crenatus*, was quite recently introduced; and it fully rivals the great-flowering species, and possesses at the same time the advantages of blooming by day, and of not having a rambling habit. Its stem is broad and flat, with regularly crenated edges; and its flowers are white, deliciously fragrant, and about five inches in diameter.—The showiest species, *C. speciosissimus*, was introduced from South America in 1816. It usually grows to the height of about a yard, and produces its superb crimson flowers in July. The Gardener's Gazette of 1841 notices a plant of it at Folkstone in Kent, which covered a space equal to 200 square feet, and generally continued in bloom three months, and which, in that season, had during a single fortnight expanded 200 of its magnificent flowers, and promised to expand altogether about a thousand.—Much and considerably successful care has been used by some of the most distinguished market florists to hybridize the most finely flowering species of cereus. See the article CACTUS.

CERIN. One of the two chemical constituents of wax,—the other being myricin. Cerin is soluble, while myricin is insoluble, in alcohol. The unctuous matter of the cinnamon berry consists wholly of cerin and a little oil. When wax is saponified by the action of a fixed alkali, a peculiar acid is formed, called ceric acid.

CERINTHE. See HONEYWORT.

CERIUM. A scarce, metallic, elementary substance, discovered, in 1803, in a rare Swedish mineral called cerite. It is obtained in minute pieces not larger than pin-heads; and is white and brittle, and resists the action of nitric acid, but is dissolved by nitromuriatic acid. It makes one combination with sulphur, and two combinations with oxygen; yet its properties are, in a great degree, unknown.

CEROPEGIA. A genus of curious and interesting plants, of the swallow-wort tribe. The name *ceropegia* signifies a "well of wax," and alludes to the amassment of the pollen into accumulations of waxy matter as in the plants of the orchis tribe. One or two species of *ceropegia* are admired for their flowers; but most are esteemed and cultivated simply for their very singular appearance. Upwards of a dozen species, all more or less tender, and principally natives of India and Australia, were introduced to Britain between 1817 and 1840. Four are tuberous-rooted, and propagable by division of the roots; two are evergreen undershrubs; and the others are twiners and trailers, chiefly evergreens, and all propagable from cuttings. Most have a height of only from one foot to eight feet; but the most handsome, *C. elegans*, is a twiner to the height of 20 feet.

CERRIS. A group of oak-trees, popularly called bitter oaks, Turkey oaks, and mossy-cupped oaks. The species *agilops*, *Quercus agilops*, belongs to this group; and comprises three

varieties, the oriental, the broad-leaved, and the pendulous. But the principal species is the *cerris* proper,—*Quercus cerris* of Linnæus, or *Quercus crinita* of Lamarck. This comprises seven varieties with deciduous foliage, two with foliage of medium habit between deciduous and evergreen, and five with foliage almost or altogether evergreen. See the article OAK.

CERT-MONEY. An annual fine, paid by the residents of some manors to their landlords, and sometimes to the hundred, for the certain keeping of the leet.

CERVICAL LIGAMENT. See NECK.

CESSPOOL. A tank or cistern for collecting and containing liquid manure. See the article TANK.

CESTRUM. A genus of poisonous, evergreen, tropical shrubs, of the nightshade tribe. Nearly thirty species have been introduced to the hot-houses of Britain; and about twenty other species have been scientifically described. The introduced species vary in height from 4 to 15 feet; and most of them are natives of the West Indies, the East Indies, and tropical America, have white, yellow, or greenish white flowers, and are propagated from cuttings in peat and loam. The cork-barked species, *C. suberosum*, introduced in 1815, and carrying sulphur-coloured flowers, is ornamental; and the orange-coloured species, *C. aurantiacum*, recently introduced from Guatemala, is one of the gayest autumn-flowering plants of the greenhouse. The outline of the latter is bushy and symmetrical; its habit of growth is free and vigorous; its leaves are smooth, wavy, and oval; its flowers are small and orange-coloured, grow in panicles or bunches, and continue for a considerable time in bloom; and its fruit are white berries, somewhat similar to those of the snowberry-tree, and combine with the foliage to give the plant a very handsome appearance throughout the winter.—The night-smelling species, or lady-of-the-night, *C. nocturnum*, was introduced in 1732; and is one of the best-known species. Its name alludes to the strong fragrance of its flowers after sunset. Its stem is upright, covered with a greyish bark, and about seven feet high; its branches are numerous and slender, and generally incline to one side; its leaves are alternate, smooth, pale green, and nearly four inches long, and one and a half broad; and its flowers have a greenish white colour, and are produced in small clusters and on short foot-stalks, but are not followed in Britain by any fructification.—The day-smelling species, or lady-of-the-day, *C. diurnum*, was introduced in the same year as the night-smelling species. Its stem is upright, and covered with a smooth, light-green bark, and about ten feet high; its leaves are smooth, lively green, similar in consistence to those of spurge laurel, and nearly three inches long, and one and a half broad; and its flowers have a very white colour, and are produced in clusters, close to the branches, from the wings of

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the leaves.—The broad-leaved species, *C. latifolium*, brought from Trinidad in 1818, and carrying white flowers in June and July, is ornamental. Most of the species are very decidedly poisonous.

CEUTORHYNCHUS. A numerous genus of small coleopterous insects, of the weevil tribe. Their larvæ infest the roots of cruciferous plants, and occasion serious damage to one or two crops of the field, and to several crops of the garden; and were the nature of their depredations properly investigated, they might probably be found to be exterminable by means of lime or of some other caustic manure. The ceutorhynchi have by no means been duly studied; and they well deserve the examination and the preventive care of nurserymen and gardeners. Their name alludes to the circumstance of their rostrum being usually inflexed beneath the breast, and in consequence concealed. Their body is very short and thick; and when, on being alarmed, they draw in their rostrum and their legs, and allow themselves to drop to the ground, they can scarcely be distinguished from seeds, or small particles of earth. One species, *C. pollinarius*, abounds on the common nettle, *Urtica dioica*, during spring and summer, and may be regarded as a sort of type of the whole genus. The larva of another species, *C. contractus*—an insect scarcely a line in length, of an uniform black colour, with punctured and slightly metallic blue elytra—occasions the knobs which may frequently be seen on the roots of the wild mustard, *Sinapis arvensis*; and the perfect insect itself of this species, is sometimes associated with the turnip flea-beetle in feeding upon the seed-leaves of newly-sprung turnip plants. One of the most multitudinous species, *C. assimilis*, occasions the knobs which appear on the roots of the very troublesome weed, wild radish, *Raphanus raphanistrum*, and probably infests some useful plants.

CHABRÆA. A genus of ornamental plants, of the jacobea division of the composite family. The changeable-flowered species, *C. runcinata*, is a handsome annual, quite recently introduced from Chili, and grown, in 1844, in the garden of the Royal Botanical Society. Its stem is branching, and about 18 inches in height; its leaves are deeply lobed, and have their lobes pointing to the base; and its flowers are French-white and double, and appear in June. The whole plant, in fact, very much resembles the well-known double jacobea or elegant senecio.

CHÆROPHYLLUM. See **CHERVIL**.

CHÆTERIA. A small genus of exotic grasses, of the agrostis tribe. Three perennial and one annual species were, about 25 years ago, introduced to Britain; but they possess little interest. The name is formed from a word signifying an awn or bristle. Another small genus, of the same tribe and similar character, bears the name of chæturus; and a hardy annual species of this, *C. fasciculatus*, was introduced in 1816, from Spain.

CHAFER. See **COCKCHAFER**.

CHAFF. The husks of corn, separated from the solid grain by thrashing and winnowing; also, the straw of oats, barley, and wheat, or the hay of clover and grasses, cut into very small pieces, as food for horses and cattle. See the articles **BARN**, **FARM-YARD**, and **CHAFF-CUTTER**.

CHAFF-CUTTER. A machine for cutting straw and hay into short chaff-like pieces, to facilitate their use as food for horses and cattle. It is also called a chaff-engine, a straw-cutter, a hay-cutter, and a straw and hay chopper.

The only chaff-cutter in use till toward the close of last century, was simply a plain box or trough, fixed on four legs and provided with a large lever-mounted knife or blade.

Salmon's chaff-cutter, invented in 1797, was a cumbrous and complicated machine, yet long maintained considerable celebrity as a valuable substitute for the old trough chaff-cutter. In this machine, two wheels were connected together by bolts inserted in their felloes; knives were fixed on the inside of the rims, with the edges adjusted at an angle of 45° from the plane of the wheel's motion; a box was fixed in front of the wheels, to hold the straw or hay, and to let the ends of it project within the action of the knives; springs were placed to press the knives forward, and wedges to prevent an excess of pressure; two spiked rollers in the box were turned from the outside by ratchet-wheels so as to keep the straw at rest during the stroke of the knives; and the feeding-arm was provided with such adjustments and apparatus that no fewer than twenty different lengths of chaff might, at pleasure, be obtained.

Passmore's chaff-engine, or the Doncaster chaff-cutter, patented in 1804, was somewhat similar to Salmon's, but much less cumbrous in its form, and considerably simplified in its mechanism. It was, for many years, the type of most of the chaff-cutters of the midland and eastern counties of England; and "even at the present day," says Mr. J. A. Ransome in his recent work on the Implements of Agriculture, "few of the machines in general use are found more effective."

Lester's chaff-cutter, or the Lester engine, patented in 1800 and 1801, was a very simple machine, and seems to have suggested the main principles on which the great majority of the many chaff-engines of recent years have been formed. Its cutter or large curved knife was fixed upon a fly-wheel, and made one stroke or cut at each revolution; the fly-wheel turned on a cranked spindle which, by means of a small hook or catch, communicated motion to a ratchet-wheel attached to the end of one of the feeding rollers; this gearing could be so managed as, at the will of the operator, to lift either two, three, or four teeth at each revolution, and make corresponding differences upon the length of the pieces of straw presented to the cutter; and the straw to be cut was pressed down and carried

forward on an endless web, which passed over one roller in the fore part and another in the hinder end of the box. Though the original form of this machine is now quite obsolete, and its contrivance of an endless web has long been generally exploded, yet machines which closely resemble it are still extensively employed.

The cylinder straw-cutter, a very distinct machine from Lester's, is modelled in the Highland Society's Museum, and described as follows in their Catalogue:—"In it the feeding is produced by a pair of grooved rollers; and the hay protruded through the cutting-box is presented to the cutters. The two cutters are fixed upon a skeleton cylinder, mounted on the fly-wheel shaft, so that two strokes or cuts are made for each revolution of the fly. The mouth of the cutting-box is formed to stand obliquely, and the edge of the cutters parallel to the axis; thus distinguishing it from those wherein the cutting-box is parallel with and the cutters oblique to the axis."

Weir's chaff-cutter is pronounced by Loudon one of the best, and is the only one noticed by him in his *Encyclopædia of Agriculture*. It has two cutters on a fly-wheel, and admits a very facile regulation of the pressure of the straw.—Corney's chaff-cutter gained a prize at the Shrewsbury meeting of the Royal Agricultural Society in 1845. It has a sliding top-roller and pressure-plate, cuts with three knives, and makes two lengths of chaff.—Dean's chaff-cutter gained prizes from the Evesham and the Gloucestershire Agricultural Societies in 1844. It has steel faces, rising-rollers, and pressure-blocks, allows the straw to advance so freely as to prevent any liability of choking, and cuts three different lengths of chaff.—Barrett's chaff-cutter cuts four different lengths; its rollers are turned and grooved spirally by machinery; and its mouth-piece is case-hardened, so as to sharpen the knives as they revolve.

The Uley chaff-cutter, *Plate XVIII. Fig. 1.*, will be noticed at some length in the article *STRAW-CUTTER*.—It gained prizes at the Royal Agricultural Society's meetings in 1841, in 1843, and in 1844. It possesses considerable novelty of principle; its cutters are thin blades, with serrated edges, coiled round a cylinder, and effect their object with much less expenditure of power than cutters mounted on the fly-wheel, and can be sharpened simply by a few retrograde revolutions of the cylinder; and a simple contrivance exists for changing the lengths of the cut of chaff.

The Canadian straw-cutter is an American invention, and acts on a peculiar principle. It was first introduced to the notice of British farmers in the Highland Society's Transactions of 1838; and it is briefly noticed, as follows, in the Catalogue of the Highland Society's Museum:—"One plain cylinder of hardwood revolves in contact with the cutting-edges of 24 knives, which are set in the periphery of an iron cylinder, placed parallel to the former,—the knives stand-

ing also parallel to the axis of the cylinder. By this arrangement, the two cylinders feed and cut at the same time by simple pressure." This machine cuts large quantities with small power, but does not make the chaff of regular lengths.

Ransome and May's chaff-engine, patented in 1840, has two shafts, with the screw which impels the rollers upon the one, and the wheel which carries the knives upon the other, and with such a connexion of the two by toothed wheels of varying diameters as easily to vary the lengths into which the straw or hay is cut; and the presser, instead of being fixed to the support of the upper roller, has a motion round the axis of it, and so rises or falls as to give the proper pressure alike to a thick feed and to a thin one. This machine is represented in *Fig. 2. Plate XVIII.*

CHAFF-FLOWER,—botanically *Alternanthera*. A genus of tropical plants, of the amaranth tribe. Both the popular and the botanical names allude to the alternate fertility and barrenness of the stamens. About a dozen species have been introduced to Britain; and about fifteen others are known to botanists.

CHAILLETIA. An evergreen shrub of Sierra Leone, forming the type of both the genus *chailletia*, and the natural order *Chailletiacæ*. This order comprises three genera, and consists of shrubs, nearly allied to those of the turpentine-tree tribe, with alternate entire leaves, and with axillary and terminal racemes of white flowers, and natives chiefly of the tropical regions of Africa. But the only species known in Britain is *Chailletia toxicaria*; and this was introduced in 1824. It attains a height of about five feet, and blooms from May till July. The kernel of its nut is poisonous, and is used in Sierra Leone for destroying rats and mice.

CHAIN. A well-known instrument used in surveying. The measuring chain is usually made of strong iron wire, with a handle at each end, by which two persons called chain-bearers carry it. The one that precedes is called the *leader*, and the other the *follower*. Any one can lead a chain, but some skill and attention is necessary in the follower, because he has to direct the leader in his movements, and to give him other instructions. The arrows or markers are always 10 in number, and are composed of pieces of strong iron wire, about 15 inches long, sharpened at the point, and bent into an eye at the opposite end, for the convenience of stringing them upon a cord or leather strap to carry them and prevent their being lost. A piece of scarlet cloth should be attached to the eye of each arrow to render them distinctly visible when stuck in the ground, particularly in the grass, as without this precaution much time is frequently lost in searching for them. In using the chain, a peg or stake is driven into the ground to mark the starting point from which the measurement begins, and the whole of the 10 arrows are given to the

leader. The follower stands at the starting stake, and places his end of the chain in contact with it, or rather holds it in his hand over it, while the leader proceeds with the other end of the chain in the desired direction, until it becomes nearly stretched or extended, when the follower gives the word *halt*, and the leader stops. The chain is now lifted from the ground and stretched, when the follower places its end carefully to his mark; and having observed that the chain is in the right direction, and not deflected by bushes or other obstacles, he gives the word *down*, and the leader places the chain upon the ground, keeping it tightly stretched. The follower having observed that all is right, calls out *mark*, when the leader sticks one of his arrows into the ground close to his end of the chain, and the first chain is completed. The bearers then both proceed onwards, and at this time the chain should be slightly strained, so as to take off its bearing against the ground, otherwise it will be liable to get entangled with weeds, or to wear out, at any rate to become elongated. The follower must look at some mark to guide the proper direction of the measurement, and will accordingly order his leader to the right or left to preserve that line. He must likewise take care to so direct the movements of his leader, that the chain in its progress may not rub against the arrow that has been left in the ground; for if that gets knocked down or displaced, the operation must commence again. Having proceeded in this manner until the follower arrives at the arrow that was left, he again halts his leader, adjusts the chain, and orders a second mark to be made; and that done, he takes up the first arrow and retains it, and so of others in succession, until the whole 10 arrows of the leader are exhausted and have come into his possession. The chain remaining stretched on the ground, the leader now comes back to the follower to take up the arrows he has picked up, and the follower registers this operation by an entry in his book, or what is more common in the measurement of long lines, by making a knot in a string that he has previously attached to his button-hole for that purpose, each knot standing for 10 chains. In this way errors seldom arise: but some surveyors, to guard against them, and insure the certainty of not having an entire line to measure over again from mistakes, use the precaution of driving a permanent peg or stake at every 10 or 20 chains, or other stated regular distances.

Simple as the common measuring chain may appear to be, it is nevertheless a beautiful contrivance of the celebrated mathematician, Edmund Gunter, who lived in London in the 17th century, and is most admirably suited to the purposes for which it is intended. It is 22 yards, or 66 feet, long, and is divided into 100 equal links, so that links are decimal fractions of a chain. The acre contains 4,840 square yards, and the chain being 22 yards long, if its length be squared,

it produces 484 square yards, or the tenth of an acre; consequently 10 square chains are an acre, and as each chain contains 100 links, so an acre will always be equal to 100,000 square links. In setting down or recording measurements taken with the chain, the number of links are placed as decimals after the number of chains, so that a piece of land containing 16,543 square chains and 75 links would be set down as 16543.75, and on taking away the decimal point, the number would be altered to 1,654,375, which would express the total number of square links contained in the land. But if the measure of a piece of land taken in square links is divided by 100,000, or the number of links in an acre, or, which is the same thing, if the 5 right hand numbers are pointed off as decimals, (which is the same as dividing by 100,000,) the figures will at once express the acres and fractions without further calculation. Thus cutting off the five decimals gives 16.54375, or 16 acres, and the decimal .54375.

The acre consists of 4 roods, therefore if this decimal be multiplied by 4, it will become 217,500 links; and now, if 5 decimals be again pointed off, it shows that the fraction is worth 2 roods and .17500; and again multiplying this fraction by 40, the number of perches in a rood, we shall obtain 300,000, and now pointing off 5 decimals, leaves 3 perches without a fraction, and shows that such a piece of land would contain exactly 16 acres, 2 roods and 3 perches. This example shows at once the process that must be resorted to for converting quantities taken in chains and links into acres, roods and perches, while the remainder, if any, will be square links.

In using the chain, it must be borne in mind that the handles at its two ends count into its length; and for the facility of counting the links small brass indices are attached at certain points among the links. Thus the 10th link from each end has a single point or brass finger attached to it; 20 links from each end has an index with 2 points; 30 links one with 3; 40 links one with 4; and 50 links, or the middle of the chain from each end, is marked by a small round brass-plate; so that by looking for these marks the distance from either end is given upon inspection, and a portion only of the next 10 links has to be counted. Many persons, for the sake of having a light chain to carry, purchase those that are made of thin wire; but they can never be depended upon, because the strength of the wire should be such as to permit the chain to be stretched without any fear of any of the links opening or expanding, an inconvenience to which even the strongest chains are liable. No chain should, therefore, be used many days in succession without an examination; and this is one use of the offset staves, which are 6 feet 7.2 long, and are divided into 10 equal parts of the same length as links; and the surveyor should have a small hammer for beating or closing up the links and thus adjusting his chain, for upon its accuracy

all his operations must depend; and in the more extensive operations of trigonometry the correct measurement of a good base line is of vital importance to the success of the whole operation.—*Millington.*

CHALK. A species of carbonate of lime. It is inodorous and insipid; and, when applied to the tongue, feels slightly adhesive. It has either a white or yellowish or greyish-white colour. It feels roughish to the touch; is pulverulent and not very hard; breaks with an earthy fracture; stains the fingers, and leaves marks on wood or stone; and has a specific gravity of from 2.315 to 2.78. But in hardness, fracture, and lustre, it is exceedingly various; sometimes occurring soft and dull, almost like a saponaceous powder, and at other times occurring hard and semi-lustrous, almost like fine limestone or coarse marble. It dissolves in water containing an excess of carbonic acid; but is very partially soluble in pure water. It readily effervesces with almost any acid, throwing off its own carbonic acid, and surrendering its calcium into combination with the foreign acid to form a salt. Most specimens of it contain a portion of alumina; and many contain portions of silica and oxide of iron. Its principal difference from limestone is its being in a large degree a hydrate, or containing, in combination with its carbonate of lime, a comparatively large proportion of water. Specimens of limestone analyzed by Thenard and Biot contained only 1.63 per cent. of water; and specimens of chalk, when carted from pits, and laid down upon land for manure, are frequently found to contain 24 or 25 per cent.

Chalk occurs in beds, strata, or vast masses in Poland, some of the Danish islands, the north of France, the north-east of Ireland, and particularly in the centre and south of England, within a range which commences at Flamborough-Head in Yorkshire, and is continued, with irregular interruptions, in Lincolnshire, Suffolk, Surrey, Sussex, and Hampshire, into Dorsetshire. While, in a geological respect, limestones occur of a great variety of age and character, from what are called the primary or non-fossiliferous rocks, up to a high part of the tertiary formations, chalk occurs only in the upper regions or among the newest members of the secondary formations, and, in its most characteristic strata, is always accompanied with flints. In many of the chalk districts of England, the crust of the earth, to a great depth, is a continuous and solid mass of chalk, and the very soil itself consists of little else than carbonate of lime and a small admixture of decomposed vegetable matter. The chalk of Ireland is very much harder than almost any of the chalk of England; and, even in spite of containing flints, and possessing other most decided geognostic indications of being in all respects chalk, it possesses so close a resemblance to fine limestone in both appearance and properties, as to be almost universally called limestone by the natives, and

as to be extensively imported into Scotland under the name of Irish lime, for exactly the same uses as the richest calcareous limestones of Britain. Some of the chalks of England, particularly of the extreme south and of the Isle of Wight, have an unctuous or saponaceous character, and ought to be regarded as akin to calcareous marl; but most are hard and flakey, and may be treated, for manurial purposes, as simply a kind of hydrated limestones.

Those soils of the chalk districts of England which consist almost wholly of pure chalk, with a small intermixture of decomposed vegetable matter, generally constitute the softly-rounded chains and groups of hills which bear the name of downs in the south, and of wolds in the north; and, in general, they are far less adapted to tillage than to pasture, and are, in consequence, very extensively used as sheep-walks. Yet the lower slopes and the valleys and hollows of the downs and wolds have received such a large commixture of the finest particles of the soil, from the constant though slow depositions of rills from the higher grounds, as to have become very productive arable lands; and they are usually farmed upon the common Norfolk system, and are found to make excellent returns of barley and of other crops. "There is a plant," says the Rev. Mr. Rhau, in reference to these districts, "which seems to delight in chalky soils, and to flourish better there than in deeper and richer earth. This is the sainfoin, *Hedysarum onorystichis*; and its introduction among the cultivated grasses has greatly raised the value of chalky land, previously considered too poor to repay cultivation. It not only produces an excellent fodder, superior to meadow hay, and scarcely inferior to clover, but by its roots it so divides and enriches the soil, that after having covered it with luxuriant crops of hay for several years, it leaves it in a fit state to produce excellent crops of grain, with very moderate manuring. Chalky soils are not subject to the same perennial weeds which infest richer lands; couch grass is seldom found in chalk; but the annuals, such as may-weed, charlock, poppy, crowfoot, and several others, abound in it. When a chalky soil produces thistles, it is an indication of its containing a portion of argillaceous earth, which improves its fertility."

Soils which have a large admixture of argillaceous earth, but which are immediately incumbent on chalk, also derive great benefit from the growth of sainfoin, but require a different course of husbandry from the slopes and hollows of the downs and wolds. Most of these soils consist of separate layers of hazel-loam, thin flinty clay, or strong red clay, of different degrees of admixture and of depth; and wherever they are sufficiently light and porous to be suitable for the growth of turnips, they should be sown at remote intervals with sainfoin, and subjected throughout the intervals to long and diversified rotations. Sainfoin cannot be advantageously repeated except

after a long interval, and ought not to enter into every rotation; and even any ordinary crop can, in few instances, be profitably repeated with the same frequency as in other soils. A good rotation on cold thin clay and flinty chalk, upon a chalky subsoil, is clover for two years, or sainfoin for five, six, or seven years, then wheat, then turnips, upon pared and burnt land, and fed off, then wheat, then pease, then turnips, cole, or tares fed off, and then oats or barley. A good rotation on a friable chalky loam is clover for one year, or occasionally sainfoin for several years, then wheat, then tares fed off, then oats, then rye or cole for spring feeding, then turnips manured and fed off, then beans, and then barley or oats with clover and grass seeds. A good rotation on a strong chalky loam, or one which contains a somewhat large proportion of argillaceous earth, is clover for one year, or occasionally sainfoin for several years, then wheat or oats, then manured fallow, then wheat, then oats, then beans, then turnips fed off, and then barley. A proper rotation for strong red clay upon a chalky subsoil does not materially differ from a proper rotation for the same kind of soil in other situations.

Chalk acts as a fertilizer in most cases in which lime is serviceable; it has a beneficial action upon soils very much in the proportion of their differing from itself in nature, or of their being deficient in calcareous ingredients; and, in particular, it exerts a most benign power upon any soil which is eminently clayey, or upon any which is eminently sandy. Yet it acts, not as a substitute for animal and vegetable manures, but as a decomposing and transmuting chemical agent upon the mineral and organic matters existing in the soil. "Pure chalk, being saturated with carbonic acid gas," remarks Malcolm, "tends to alter the original disposition of the parts of the soil, where it meets with various substances, either vegetable, animal, or mineral. The substances becoming oxygenated by their action with the chalk, generate their several acids; and these acids disengage the carbonic acid gas, which is readily absorbed by the roots of the plants. It therefore tends, by slow degrees, to separate the cohesiveness of the strong soil, and to admit the roots of the plants to feed upon the carbon with greater facility." Chalk, though not a substitute for manure, has thus such an effect upon both the texture of the soil and the decomposition of organic matter, as to render a smaller dose of farm-yard manure or any other carbonaceous compost effective. It corrects the sourness and astringency of wet clayey soils, absorbs and throws off their moisture, and prevents them from cohering into such solidity as to constrict the roots of plants and limit the circulation of the atmospheric air; it gives consistency to arenaceous soils, and binds them into sufficient firmness to retain a due proportion of moisture, and to afford requisite mechanical support to

plants; it renders all clayey and loamy lands more workable, both in the free transit of the plough or the grubber, and in the ready and minute intermixing of the manure; it rapidly and vastly improves the herbage of coarse sour pasture, stimulating the dormant seeds of white clover and fine grasses into activity, and causing their fine, sweet, delicate leaves to form a soft, dense, and nutritious sward, and to smother the rank and rush-like vegetation which formerly abounded; and it exerts a cooling and conservational power upon pastures of a hot, gravelly, loamy soil, maintaining a succulency in the roots of their herbage, preventing their tender grasses from being exsiccated and burnt by the ardent heats of summer, and, if they be subject to the growth of sorrel, so noxious to lambs and sheep, everywhere destroying its roots, and freeing them from its presence.

Chalk, as an eminent and lasting fertilizer of cold sour lands, and of stiff untractable clays, has been known since before the time of the Roman naturalist, Pliny, and makes a very prominent figure in the English agricultural writings of the early part of last century. An experienced Essex farmer, writing long ago in the *Museum Rusticum*, gives an excellent account of the manner in which chalk operates upon clay lands, and observes that it insinuates itself into the small pores, and, by raising a fermentation, exposes the clay to the influence of frost, rain, air, and sunshine, and in consequence occasions it to become pulverized and friable. "But," says Mr. Lisle, "if chalk be laid on clay, it will in time be lost, and the ground again return to its clay; and if the clay be laid on chalk, in time the clay will be lost, and the ground return again to its chalky substance. Many people think the land, on which the other is laid for a manure, being predominant, converts the manure into its own soil; but I conceive, in both cases, the chalk and clay is filtrated through the land, on which it is laid, by time, and, being soluble by rains into small corpuscles, is washed through the land on which it is laid; for neither of these manures is able to unite, in its finest corpuscles, with the corpuscles of the land on which it is laid, so as to form so strict an union and texture with it as the land doth with itself, and is therefore liable to be borne downwards with rains, till no sign of it be left. It is said to be a common practice with many tenants in Hampshire, three or four years before they leave their farms, to chalk their meadows; by which means they will, for three or four years, fling out a great crop of grass, but that they will be much the worse for it ever after. This seems to carry some reason with it; for the chalk so mellows and opens the pores of the meadow, that it enables the land to exhaust its strength in all parts; for chalk does not carry so much fatness as dung does to the land it is laid on; but it disposes the land to bear such crops by its sweetness, and well disposing of, and correcting an ill

quality the land had before: but still I do not see that this is any objection to the chalking of meadows, provided, whilst by virtue of the chalk, they are bearing such burthens, you take care to refresh them with dung. Though chalk laid on meadows enables them to give a great crop for three or four years, and will then impoverish them, yet I take it to hold quite contrary on pasture; for the grass being thereby so much sweetened and increased, keeps constantly so much the more stock, by which it is maintained always in the same vigour."

The unctuous, soft, and saponaceous kinds of chalk are the most suitable to be used in a crude state, or in the manner of marl; and the hard, dry, and firm kinds are the most suitable to be used in a burnt or calcined condition, or in the manner of lime. The principal good effects of burning hard chalk are to lessen its weight by driving off its water, and to render it more capable of easy and equal spreading upon the ground by reducing it to a state of powder. In the districts in which chalk is most abundantly employed as a fertilizer, it is, for the most part, either mixed with earth or manure before being distributed athwart the land, or laid down in autumn, and not ploughed in till it has been acted on by the frosts of winter. The quantity of it applied to pasture commonly varies from 150 to 250 bushels per acre, and, on arable land, from 200 or 300 to 700 or 1,000 bushels; but, in both instances, it is very generally determined by mere caprice or convenience, without any appeal to scientific principle, or any reference to either the comparative richness of the particular chalk employed, or the degree of calcareous poverty or destitution of the land to which it is applied. It can, in any case, be economically employed only when found either below the fields on which it is used, or at a comparatively brief distance; and it ought always to be applied with strict adaptation to the calcareous wants of the land. One dressing, if sufficiently rich and properly applied, will slowly and regularly operate upon the soil through a somewhat long series of years; and a second should not be applied till the first has been allowed to expend the greater part of its power, or usually till a lapse of 12 or 15 years.

Chalk may be dug and carted throughout July, August, and September, when it is designed to lie on the land unploughed-in till spring, and throughout October, November, and December, when it is designed to be applied and covered in a state of mixation with earth or manure. When a stratum of chalk exists beneath the field to be dressed with it, and at no greater depth than twenty feet from the surface, a shaft of four feet in diameter is opened to it, and is propped round the sides with a basket-work of hazel or willow rods and brushwood; the earth of the shaft and the chalk of the stratum are brought up by means of a rope and bucket upon a very rude and inex-

pensive windlass; one man fills the bucket, and two others wind it up, and distribute its contents with a wheel-barrow upon the surrounding land; and when the stratum is worked in chambers to the depth of about thirty feet from the surface, the first shaft is abandoned, and another at a little distance is opened. One shaft, in an average case, supplies sufficient chalk for six acres, at a cost of about sevenpence for every twenty bushels. When strata of good chalk occur close to the surface, and constitute the substance of hills, a large excavation is made in the form of a quarry; and affords a supply, by means of carting, to a considerable surrounding district.

The chalk of the uppermost three or four feet of a chalk formation, especially when it occurs close to the surface, is usually very inferior in quality to that which lies at a greater depth; but this, as well as any better kind of chalk, serves well for making and repairing roads in districts where stones and gravel cannot easily be obtained. Many varieties of chalk are very serviceable also for making mortar, and for several other coarse purposes to which the lime of limestone districts is commonly applied. Chalk may likewise be very servicably employed for making ponds on thirsty land, away from streams and springs, for the use of cattle; and if laid several inches thick, and covered with a coat of sand and gravel, it will thoroughly retain a collection of rain-water, and preserve it in a clean and sweet condition. Powdered chalk may, in small quantities, be thrown into all cattle-ponds, for the correction of acidity; and a lump of it should be laid in every pen of a fattening calf, for the animal to lick. Prepared or levigated chalk, in a state of fine powder and of freedom from all impurities, is externally applied, in veterinary surgery, to ulcers which make a thin and ichorous discharge, and internally administered, in combination with catechu and opium, as a remedy for dysentery and diarrhoea. "There are few cases of illness in oxen, sheep, or swine," says Clater, "in which there is not considerable acidity in the stomach or bowels. Chalk is useful as being an alkali, and combining with the acid, and neutralizing it. It should form a part of the cordial and astringent medicine of all young animals. From half an ounce to an ounce will be a dose for a cow; a drachm will suffice for a sheep or hog. It should generally be accompanied by opium, and always by caraways or ginger." Prepared chalk is used externally for ulcers and burns, and internally for the correction of acidity and the cure of dysentery, in the human subject as in the horse. Yet it ought by no means to be administered to any animal with the freedom and frequency which Clater seems to recommend; for it has a considerable tendency to create concretions and calculi. See the articles CALCULUS and DYSENTERY.—*Lyell's Geology*.—*Griffith's Reports on Ireland*.—*Parliamentary Gazetteer of England and Wales*.—*Malcolm's Husbandry and Man-*

ures.—*Museum Rusticum*.—*Lisle's Husbandry*.—*Marshall's Midland Counties*.—*Young's Farmer's Kalendar*.—*British Husbandry*.—*The Farmer's Magazine*.—*Rham's Book of the Farm*.—*Thomson's Dispensatory*.—*Youatt on the Horse*.—*Clater's Cattle Doctor*.—*Doyle's Husbandry*.

CHAMÆDOREA. A genus of small, ornamental, tropical trees, of the palm tribe. Two species, the fragrant and the slender, about 8 or 10 feet high, have been introduced to Britain from respectively Trinidad and the Caraccas. The low growth of the trees, and especially their habit of low flowering, are alluded to in the name *chamædorea*, which signifies 'a gift to the ground.'

CHAMÆROPS. A genus of low-growing, ornamental, greenhouse and hothouse trees, of the palm tribe. The low, dwarf, or fan-palm species, *C. humilis*, is a native of Spain and Portugal, and was introduced to Britain in 1731. In its native country, particularly in Andalusia, it propagates itself with such rapidity, and has such a stemless and leafy habit, as to cover large tracts of ground in a manner very similar to that in which ferns cover dry woody tracts in Britain. The footstalks of the leaves rise immediately from the crown of the root, and are flat on their upper surface, convex on their under surface, and armed on each side with strong spines; and the leaves are attached by the centre to the ends of the footstalks, and have a fan-like form and many foldings, and are deeply divided at the top like the human hand with its fingers, and have their borders finely serrated, and adorned with white narrow edgings,—and they measure from 9 to 18 inches in length, and nearly a foot in maximum breadth, and spread out on every side of the plant. When the leaves are newly formed, they appear like a shut fan, and are fastened together by strong fibres which run along their borders; and when they become matured and expand, the fibres or strings hang from their sides and ends. The spadix or club which sustains the flowers grows up from among the leaves, and is covered with a thin spatha or hood, which falls off when the bunches open and divide. Mr. Otto, the inspector of the Royal Botanic Garden of Berlin, said, about 20 years ago, respecting a plant of *Chamærops humilis* under his care: "It is supposed to have been brought from Holland upwards of 171 years ago. After having been many years in a tub, and exposed to the open air during every summer, it was, about the end of last century, planted in the floor of a hothouse, and has since ripened fruit, from which plants have been raised, and which are still in the garden. Its height is 18 feet, which may be considered extraordinary, as, in its native situations in Spain and Portugal, it forms a bush seldom higher than two feet. But the most remarkable circumstance connected with this palm is, that it was the subject of the experiment cited by Linnaeus, as a proof of the sexual system of botany.

In this experiment, the palm is said to be the *Phoenix dactylifera*; but this mistake was corrected by Peter Collinson, who travelled in Germany during the seven years' war, and, when he was in Berlin and saw the palm, wrote the true name on a slip of paper, and stuck it in the tree."—Six other species of *chamærops*, varying in height from 10 to 30 feet, have been introduced to Britain since the commencement of the present century, three from the southern states of North America, two from the tropical parts of South America, and one from Nepaul.

CHAMOMILE,—botanically *Anthemis*. A large genus of plants, principally herbaceous, forming the type of a suborder of Compositæ. This suborder comprises about 20 genera,—among others, the well-known yarrow, feverfew, tansy, wormwood, wild chamomile, and ox-eye daisy. The proper chamomiles, or plants of the genus *Anthemis*, comprise five British species, and about 50 known foreign species; and most of the latter have been introduced to the botanical collections of Britain, while not a few are far from being uncommon in flower gardens. The globose species, in particular, *Anthemis globosa*, has been known in British greenhouses as an elegant herbaceous evergreen, since a little after the middle of the 16th century. One of the British species, *Anthemis arvensis*, is a biennial white-flowered weed of dry fields; another, *Anthemis cotula*, is an annual white-flowered weed of corn-fields; another, *Anthemis anglica*, is an annual trailer of some of the maritime parts of England; another, *Anthemis tinctoria*, or dyer's chamomile, is a yellow-flowered, perennial-rooted inhabitant of stony places, and of some little use as a dye-stuff; and another, *Anthemis nobilis*, is a creeping, low-growing, herbaceous evergreen of some pastures, but is also the cultivated medicinal chamomile of cottage gardens, so well known and so much in vogue as often to usurp the name and honours of the whole genus. The flowers of this last are the parts used in medicine; but those of one variety, frequently called the Scottish chamomile, are single; while those of the more commonly cultivated variety, frequently called English chamomile, are very double. Both varieties are white-flowered, and usually bloom from July till September. Chamomile flowers, such as they are found in the shops, are white, desiccated, of a very aromatic and rather pleasant smell, and of a very bitter and warm taste. They contain an essential oil, of a fine blue colour, a gummo-resinous principle, camphor, and tannin. Water and alcohol dissolve their active principles. Chamomile is a moderately energetic stimulant, possessing, on account of its bitterness, some tonic properties, which have rendered it a popular remedy for a number of diseases. It is employed with success to stimulate the digestive functions in dyspepsia, chlorosis, gout, in flatulent colics, &c. It is also advantageously used in slight intermittent fevers, and spasmodic affections. A

strong infusion, taken warm, and in a large quantity, provokes vomiting; in consequence of which it is used in this manner in order to assist the action of emetics. It is also administered with advantage as an anthelmintic. The pulverized flowers are an excellent mild tonic to both horses and cattle; and are peculiarly suitable either during the presence of low fever, or in other cases in which stronger tonics might have too powerful an action.—Wild chamomile, *Matricaria chamomilla*, is a very common, annual, white-flowered, pinnate and linear leaved weed of the road sides, waste grounds, and freshly turned spots of Britain. It was formerly of great repute as a remedy for uterine diseases; and after having gone almost quite out of use, it has recently come again into great request in connexion with homœopathy.

CHAMPACA,—botanically *Michelia champaca*. A beautiful, tropical, evergreen timber-tree, of the magnolia tribe. It is a native of India, and was introduced to Britain in 1779. Its stem usually grows to the height of about 20 feet. Its timber is employed by the Hindoos in making drums. The pulverized bark of its root is used to excite the flow of the menses. Its flower has a golden colour, eminent beauty, and so powerful an odour that bees will not alight upon it; and it is held in high estimation by the Hindoos, and dedicated to Krishna.

CHANGE OF CROPS. See **ROTATION**.

CHANGE OF SEED. See **SEED**.

CHARD. See **BET** and **CARDOON**.

CHARCOAL. A well-known black substance, which possesses many singular chemical properties, the details of which are given under the article **CARBON**. In the present article we shall confine ourselves to the modes of preparation employed in Britain and in France, and to its economical uses.

Charcoal which is employed as fuel, is obtained generally from wood of different kinds; the most dense and hard being preferred. The white and resinous woods are commonly rejected. Large timber is seldom employed for this purpose, both because it is too expensive, and because it does not yield charcoal equal in quality to that procured from coppice wood. Pieces of three or four inches thick must be cloven into four pieces. It is an object of some moment to ascertain the most productive wood in the preparation of charcoal; and although accurate results are not to be expected on the great scale, yet experiments made by Mr. Mushet afford very good general proportions, which may be the rule by which the products may be estimated.

The following table exhibits very satisfactorily the results of these experiments.

100 parts of		Colour.
Lignum vitæ afforded	26·8 charcoal,	greyish.
Mahogany - -	25·4 —	brown.
Laburnum - -	24·5 —	velvet black.
Chestnut - -	23·2 —	glossy black.

Oak - - -	22·6 charcoal,	black.
American black beech	21·4 —	fine black.
Holly - - -	19·9 —	dull black.
Sycamore - -	19·7 —	fine black.
Walnut - - -	20·6 —	dull black.
Beech - - -	19·9 —	dull black.
American maple	19·9 —	dull black.
Norway pine -	19·2 —	shining black.
Elm - - -	19·5 —	fine black.
Sallow - - -	18·4 —	velvet black.
Ash - - -	17·9 —	shining black.
Birch - - -	17·4 —	velvet black.
Scottish pine -	16·4 —	brownish.

In Scotland very large quantities of charcoal are prepared for the iron works, in the following way:—A platform, having a diameter of from twenty to thirty feet, is formed on the ground, by laying strata of earth upon it, and giving it a slightly convex surface. On the centre of this circular area, a circle of sticks are so placed as to cross each other a little below the top, and thus to form a cavity resembling an inverted cone, around which successive concentric layers of truncheons, having a diameter of from one to ten inches, are placed; care being taken, that the truncheons in the same circle are of the same size, and as few interstices as possible left. The exterior circle is composed entirely of brushwood.

When the platform is nearly covered, a coating of turf is laid on the pile, the grassy side being next to the wood; dry earth is then heaped up around the lower part, and well rammed down, so as to exclude all air. The pile is then lighted, by placing a few inflamed chips of wood in the interior cavity; and when these are consumed, others are added during the first three or four days. When the upper part of the pile is completely inflamed, a row of holes, each of which has a diameter of two inches, is made around it at a few inches below the top, and the opening at that part is closed up. The flame then gradually descends to the circle of holes, and its arrival there is announced by a very perceptible diminution of smoke and vapour. Another row of air holes is then made at a distance of six or eight inches below the first row, which are closed up; and the same operation is repeated until the flame has been conducted to the lowest part of the pile, which generally happens in about a fortnight; when the whole is carefully covered until the fire is extinguished. Such pieces as are not completely charred, are separated, and reserved as fuel for the next pile. The charcoal produced from the truncheons is laid aside for particular uses; and that obtained from the brushwood is sold, under the name of small coal, as fuel.

In France there is some difference in the mode of preparing the charcoal: it therefore is worth while to give an outline of the various processes there adopted. The wood is cut down in large faggots, and after having been well dried for some months, it is divided into brushwood, small and large faggots. The last are cut into truncheons of three or four feet in length. The turf is then taken off a square or circular space, having a

diameter of about fifteen feet, and the earth beaten until the surface becomes dry and solid. A stake is next fixed in the middle of the area, and some brushwood laid on the surface as a foundation for the remainder. A stratum of truncheons is then laid on the brushwood, and the same alternatives are repeated, until the pile is completed to the height of about six feet in the form of a truncated cone or pyramid. As soon as this is done, the whole surface of the pile is covered to the thickness of about two inches with dry earth, over which sods are very compactly laid, except at the base, where considerable spaces are left between them. The central stake is now withdrawn, and the cavity is filled with chips, which are lighted at the top; the whole of the chips become inflamed, and, after a considerable quantity of smoke has been poured out, a light flame rushes from the chimney in the centre of the pile; the aperture of which is immediately closed by laying a piece of turf over it. During the next ten or twelve hours, considerable attention is necessary to prevent any mischief resulting from the sudden disengagement, and consequent combustion of carburetted hydrogen, which take place during that period of the manufacture. The explosion is announced by a rumbling noise, and seldom does any other injury than that of throwing off some portion of the covering, and through the opening thus formed flame and smoke issue. It is necessary to close up all such openings with a few spadefuls of dry earth. When the smoke decreases, and the explosions have entirely ceased, the interstices between the sods at the lower part of the pile must be closed. At this stage little attention is required, the combustion gradually extends to the surface, and in about thirty or thirty-four hours after the process commenced the whole pile becomes a glowing mass. The wood is thoroughly charred, the whole is covered with dry earth, and in four or five days it may be taken down. The particular stage at which it is proper to do so, is determined by making a small opening into the pile: if no flame appears, it is fit to be taken down; if it bursts forth, the aperture must be again closed, and allowed to remain so for another day.

Great nicety is requisite in the preparation of charcoal for the manufacture of gunpowder and other delicate chemical processes. And the manufacturers select the stems of the willow, alder, dogwood, and some others, which they prepare with peculiar care. In most of the large manufactories, the charcoal is distilled from iron vessels; by which means it is obtained in a state of considerable purity, and the other products are saved. As all charcoal contains minute portions of earthy and metallic substances, lamp black is commonly used in nice chemical experiments. Lamp black is obtained by the turpentine manufacturers, from the combustion of the refuse of their operations in furnaces appropriated to that

purpose. The smoke deposits itself on the sack- ing which is hung up; it is swept off, and sold for common use, without further preparation. The lamp black in this state contains some oil, which is separated by being heated to redness in a close vessel.

The chief consumption of charcoal is as fuel. It is also employed as a tooth powder, and to purify tainted meat. No mode of preparation for the first of these objects is at all necessary; and for the two last, it must merely be reduced to a fine powder. It forms a part of all reducing fluxes. It is an indispensable constituent of gunpowder. It is the basis of most black paints and varnishes. It is used to polish brass and copper, and is an excellent clarifier. It is used, in farriery, in combination with linseed meal, as an antiseptic cataplasm for cracked heels and foul and fetid ulcers.

Powdered charcoal must be heated to redness in a covered crucible, with an opening in the middle of the cover, and kept in that state till no flame issues out; it must be then withdrawn, allowed to cool, and then put into close vessels and kept for use. Whenever either wine, vinegar, or any other fluid is to be clarified, it is simply to be mixed with the liquor; a froth appears at the surface, and after infiltration it is pure and colourless.

Charcoal has of late years become known as a valuable general manure, and as a powerful means of securing and accelerating the propagation of tender garden plants by means of slips and cuttings. In an Italian cyclopædia of agriculture, the *Biblioteca Agraria*, edited by Professor Joseph Moretti and Carlo Chiolini, it is said: "From numerous experiments made by the Abbé G. Piccone, charcoal is considered as an efficacious manure. It consists principally of oxide of carbon, the primary element of vegetable productions, and is, therefore, undoubtedly calculated to be employed for the purpose specified. According to the above author, every sort of charcoal, whether of oak, chestnut, or of any other sort of wood, the refuse of the charcoal, the small particles, or still better the dust, can be used as manure for every species of plant and in every soil. The charcoal of close-grained wood, therefore, should be the richer in nutritious particles, as it contains less ashes and earth. The effect is more speedy and vigorous according to the fineness of the pulverization of the charcoal; if it is coarse the effect is weaker but more durable. When the charcoal is intended to manure a field for several years, or the roots of vines and fruit trees, it is not necessary to pulverize it very fine. It is sufficient in such cases to triturate it so that the largest pieces may not exceed the size of a vetch. The means used for triturating the charcoal are, the olive-presses, mallets, and large pestles of iron or heavy wood, suspended from a beam of wood like that of turners' and many other machines. The dust which

is produced during trituration is easily laid by sprinkling it with water. When the pulverized charcoal is to be used in flower-pots, in furrows, in seed-pans, or in seed-beds, it is sprinkled on the surface and incorporated with the spade or with the watering-pot. This may also be done after the plants have germinated, and are 2 or 3 inches high, according to the nature of the species. In sown fields the same method is followed in applying it as with manure. Therefore, in treating ground burnt up by the sun, according to the opinion of the Abbé Piccone, it is laid on the ground towards spring, when French beans are to be sown, to preserve them from drought; to these succeed common beans, and afterwards wheat or any other grain without manure. In soils less arid, the rotation is begun with potatoes, hemp, buckwheat, and wheat. In every case the seed should be used sparingly. On artificial meadows charcoal dust is sprinkled in spring on the surface, as is practised with chalk and lands containing saltpetre. As to the quantity, the Abbé Piccone computes about an equal weight between charcoal and woollen rags, skins, and even scrapings of bones: a rubbo (about 18 lb. avoirdupois) of charcoal to two of new urine; three of night-soil well digested; four of fresh, and six of common manure. After this, he advises, for olive-grounds, vineyards, orange-gardens, or orchards, to allow an interval of four years for the first time, five for the second, and six for the third, and so on between every manuring, taking care always to increase the quantity according to the growth of the trees."

About six or seven years ago, M. Lucas, a very talented assistant in the botanic garden of Munich, accidentally discovered that some hothouse plants, whose roots found access to charcoal ashes, displayed an extraordinary vigour of growth; and he and other distinguished cultivators afterwards made several series of careful and multitudinous experiments, the results of which appeared to show that charcoal roots cuttings and slips of some plants which can with difficulty, if at all, be rooted by any other known means,—that it facilitates the rooting of cuttings and slips of many plants which are usually rooted in ordinary soils,—that it exerts a healing or restorative power upon many sickly plants,—and that, in a state of mixation with the several kinds of ordinary soil, it acts as an excellent general manure, and can be made greatly conducive to the most common purposes of both field and garden cultivation. Dr. A. Buchner, Sen., writing in the '*Garten Zeitung*,' makes pointed reference to these "numerous experiments and observations," pronounces them to be "very important contributions, not only to vegetable physiology and dietetics, but also to the founding of a vegetable therapeutic system," and makes a very clear scientific statement, though necessarily but a theoretic one, of the manner in which he supposes the charcoal to produce its beneficial effects.

The following is the most important portion of his statement:—

"1. *Absorption of Light, and Generation of Heat*.—It is well known that bodies receive the light of the sun the more perfectly, the darker, duller, and looser they are, and that the consequent development of heat is in proportion to this absorption of light; hence, a black light soil is, under the same circumstances and relations, much more favourable to vegetation than a light-coloured, grey, heavy earth. Heavy clayey soil, with a deficiency of humus, is less suitable to vegetation, inasmuch as it soon loses its porosity through rain and snow, and assumes a smooth surface, by which it is prevented from absorbing air and light, and generating heat. Hence agriculturists justly name these clayey soils, which are deficient in humus, cold soils. As charcoal dust is one of the darkest, dullest, and most porous of bodies, it must, on account of its peculiar capacity of receiving the sun's light and changing it into heat, be particularly favourable to vegetable life.

"2. *Absorption of Atmospherical Air*.—Among all porous bodies that have the capacity of absorbing gases and vapours, charcoal has been proved by numerous experiments to hold the first rank. If, therefore, clayey soil, deficient in humus, is in general less suitable to the growth of plants than rich loose garden mould, the reason lies, not only in the latter receiving more light and creating warmth, but also in its more readily condensing, by its greater porosity, the constituent parts of the atmospheric air, and consequently supplying oxygen, nitrogen, and carbonic acid gas for the nourishment of the spongioles. We come here to a very important point, the nourishment of plants, which I cannot slightly pass over in elucidating the theory of the effects of charcoal in this respect. Modern vegetable physiologists are, for the most part, of opinion, that plants can receive no solid nourishment from the earth; that is, that every thing that they can assimilate must be in a liquid and gaseous or vapoury state. If we, therefore, meet with siliceous earth, chalk, magnesia, oxide of iron, in short, such substances in plants as could only be received from the soil, we may always consider it certain that these sorts of matter can only be absorbed by the roots in proportion as they are in a fluid or dissolved state in the soil. These sorts of matter, and particularly the different organic salts which we find in the ashes of vegetables, are not actually to be considered sources of nourishment, but stimulants to assist in digesting, as salt and spice are to the higher animals and man; we also not unfrequently observe, that a superfluity or mixture of certain inorganic substances in the soil, prejudicial to certain families and species of plants, is the cause of disease when this inorganized matter is in a dissolved state, and capable of being absorbed by them.—If we analyze the nourishment of plants, we shall find it is only the con-

stituent parts of air, water, and charcoal. The experiments of Boussingault on the origin of nitrogen in organic bodies show, 1st, that no plant exists without a proportion of nitrogen; and 2d, that, while men and animals receive the portion of nitrogen of their bodies not from the air by breathing, but from food by assimilation, plants on the contrary draw their supply of nitrogen, not from manure or humus, but from the air. We come now to a very important point in the nourishment of plants, to which M. Payen has particularly called our attention in two treatises read before the Academy of Sciences at Paris, on the 8th and 14th of October, 1839: viz., that charcoal operates as a condenser, under the influence of water, on the constituent parts of the air, in the same manner as spongy platina on the elements of detonating gas; so that nitrogen and oxygen are dissolved, and, mixing with water, are absorbed by the spongioles, and carried to the cambium for assimilation. This property of condensing the air, and making it fit to be received by plants, does not exclusively belong to charcoal, for it is also more or less perceptible in other sorts of earth, chiefly in porous and pulverized bodies. We know that water, even when not distributed through charcoal or earth, absorbs some air, which becomes a watery fluid, and by heating is again expelled in the form of gas: but charcoal-powder appears to possess this power in the highest degree; consequently, besides light and heat, is capable of carrying to the roots both air and water, i. e., nitrogen, hydrogen, and oxygen, in the greatest abundance.

"3. *Decomposition of the Charcoal, and Formation of a nourishing Substance for Plants.*—It is well known that manure, as such, does not nourish plants, and that, on the contrary, when it touches the roots it causes disease. We know that it is the constituent parts of the humus, i. e., the matter produced by decay, which nourish plants. This apparently takes place because the humus, with the co-operation of air and water, is continually forming oxide of charcoal, or carbonate and nitrogen, which, together with the saline particles, is absorbed and assimilated by the roots. For a long time it was generally believed that charcoal, as an inanimate body incapable of decay, contributed in no degree to the nourishment of plants, and that charcoal-dust could only serve at most to make the earth looser and warmer. But M. Lucas found, from his experiments, that the charcoal in which plants grow by degrees undergoes decomposition, and at last becomes a sort of humus. This obviously takes place merely because the charcoal dust acts as humus, and, with the co-operation of water and air, continually gives out to the plants oxide of charcoal, or carbonate, together with the saline particles which are in the charcoal, and remain in the ashes after burning. But, to prove this, some chemical experiments were necessary.

"4. *Antiseptic Power of Charcoal.*—In judging

of the effects of charcoal on vegetation, its antiseptic properties are of great importance, for it has very little power of retaining water, and the little it retains is partly absorbed by the roots and partly evaporated. This property deserves the greatest attention of gardeners, in respect to recovering the health of plants the roots of which have become injured by being in a clayey soil, and too freely watered, or after continued rain, or being in contact with manure not sufficiently decomposed. They should be immediately transplanted into charcoal powder, as the most effectual method of cure."

Liebig, though not offering any lengthened explanation, but speaking as if the point were more a matter of long-established notoriety, than of recent experiment and theory, gives his powerful testimony in the same direction as Buchner, and says, "Charcoal, in a state of powder, must be considered as a very powerful means of promoting the growth of plants on heavy soils, and particularly on such as consist of argillaceous earth." Two sets of interesting and successful experiments were recently made upon the growing of turnips with charcoal manure,—the one with common wood charcoal, by the Earl of Essex,—the other with peat charcoal by W. Uppleby; and both are recorded in the volume of the Royal Agricultural Society's Journal for 1845.—*Philosophical Magazine*, vol. iii.—*Annales de Chimie*, vols. xxxi, xxxii, xxxvi, xlii.—*Nicholson's Journal*, vol. iv.—*Loudon's Gardener's Magazine*, vols. xvii. and xix.—*Journal of the Royal Agricultural Society*, vol. v.—*Marshall's County Reports*.—*Liebig's Chemistry of Agriculture*.

CHARGE. A thick adhesive plaster, applied warm to a weak or diseased part of a cow or a horse, and taking so firm a hold of the hair and the skin as to remain for a very long time closely attached. Charges are far less frequently used in modern than in former veterinary practice; yet, in the case of several kinds of weakness and disease, they might still, with eminent advantage, be uniformly employed. In any case, a charge may protect from cold, and serve as a bandage; in rheumatism, it not only protects from cold, and supports the limb, but gently stimulates with its resin; and in windgalls, old lamenesses, and other complaints which require to be blistered or fired, it follows up the action of the chief remedy by serving as a continued bandage. A mixture of resin or burgundy pitch with wax or oil serves for any ordinary charge, but ought to be applied in a half-melted condition, and covered with flannel or short tow as it cools; and, when a locally strengthening influence is desired, armenian bole, litharge, crocus metallorum, or any similar substance may be added.

CHARLES' SCEPTRE. See **PEDICULARIS**.

CHARLOCK. Several yellow-flowered weeds, which infest corn-fields, and belong to the cruciferous tribe of plants. The chief is the corn charlock mustard, *Sinapis arvensis*. This is an

annual; and sometimes, in spite of all precaution, especially in fields which have been dressed with police manure, occurs in so great profusion as, when in flower, to spread a sheet of yellowness athwart the whole of the corn crop. Its stem is rough, and usually about 20 inches high; its leaves are rough and sublyrate; its pods have the appearance of being swollen, and are about three times as long as their slender two-edged beaks; and its seeds are multangular and smooth. When it infests a drill-sown crop, it ought to be destroyed by the hand-hoe; and even when it infests broadcast crops, it may, in some instances, be pulled up by hand. When it is permitted to grow to maturity, its seeds, in the course of the labours of the barn, ought to be carefully and thoroughly separated from the corn with which they are intermixed; and when they exist in any considerable quantity, they may be sold, along with rape-seeds or any other oleiferous seeds, for crushing.

Black mustard, *Sinapis nigra*, another indigenous annual of the mustard genus, is also sometimes called charlock. But both of two native varieties of this, the common black, and the turgid black, are cultivated plants, and usually grow to the height of four feet, and ought no more to infest corn-crops than any two of these crops infest each other. See the article MUSTARD.—The wild radish, *Raphanus raphanistrum*, an annual weed of the radish genus, is somewhat frequently called charlock, and fully contests with the corn charlock mustard the ingloriousness of being a troublesome weed. Three varieties of it, with respectively yellow, white, and purple flowers, grow wild in Britain; and all infest corn-fields, and bloom in June and July. Its stem is beset with rigid hairs or bristles, and usually attains a height of about 20 inches; its lower leaves are lyrate, its upper ones are stalked, and both have a glaucous green colour, and are beset with hairs or bristles; and its pods are smooth, one-celled, and jointed, and contain each from three to eight seeds. When it cannot be weeded out, and exists in considerable proportion, its seeds ought to be separated, and may be sold and used, in the same manner as those of the corn charlock mustard.—Plants of rape, *Brassica napus*, when growing wild, or when rising from stray seeds of cultivated rape, are also sometimes called charlock; but besides being biennials, they affect different soils from either the mustard or the wild radish, and are of comparatively rare occurrence, and but inconsiderable annoyance.

The mustards and the wild radish not only impoverish the soil, and rob useful plants of a large portion of their nourishment, and occasion great trouble and damage by the intermixation of their seeds with corn, but also afford nutriment and protection to the turnip beetle, and preserve it in the ground during the years of a rotation which intervene between the crops of turnips. "Few weeds," remarks Mr. Shier, "are

so difficult to deal with as *Sinapis arvensis* and *Raphanus raphanistrum*. Their seeds are extremely tenacious of life; a deeper ploughing than usual, will often, in lands long infested with them, cover the whole surface of the ground, the seeds having lain dormant for many years. Some instances have come under my own observation, where the seeds of the *Sinapis arvensis* have vegetated freely after being buried for more than 40 years. These weeds appear in greatest abundance among the white crop taken after lea, and in the land preparing for fallow crops. In the latter case, when the weather is favourable, two or more crops of weeds may be made to vegetate, and be destroyed in a single season. In the former case, they are more difficultly subdued; but a turn of the harrows, after the grain plants are in their second leaf, will destroy a great many, and hand-weeding must do the rest. All the plants of sinapis, however, that escape, ripen, and mostly sow their seeds before the white crop can be gathered in. In some seasons, it happens that a considerable number of cruciferous weeds must be allowed to stand, and are cut and housed along with the grain; and unless their seeds are carefully separated from the dressed grain by a seed-sieve, they may be again sown with the seed-corn. The pod of the raphanus is indehiscent, that is, it does not burst as that of the sinapis does, but breaks into joints, each containing a seed. These may be separated by what is termed a bere-riddle, through which the grain passes while the joints are retained. The best winnowing-machines are now provided with both these sifters."

Mr. Lisle observes, that cold wet lands are always more subject to charlock than chalky or dry and light lands; and he assigns as the reason, that charlock-seeds, in consequence of being very oily, resist putrefaction, are not easily opened or penetrated by moisture, and require for their germination a longer and steadier wetness than usually occurs on chalky or sandy lands. When charlock-seed and turnip-seed are sown at the same time, the charlock is seven or eight days later in appearing above ground than the turnips; and as the two plants closely resemble each other in appearance, and are very liable to be mistaken for each other in weeding, this fact ought to be of some practical value to a farmer. A person who had vast quantities of charlock in a field of barley, mowed the whole when the charlock was in flower, as low as he could without cutting off more than the tops of the blades of barley; and he had the satisfaction of seeing the corn-crop rising quite above the weed, and of reaping from the field four quarters of barley per acre. Mr. Marshall found a field of neglected and unhoed young turnips overgrown with *Sinapis arvensis* and *Brassica napus* a yard high and as yellow as a rape field; and, for the sake of experiment, ordered part of it to be mown high enough to prevent injury to the turnips, and low

enough to get beneath the pods of the charlock, and to be strowed over an adjoining pasture-ground for the use of sheep and cattle. "Sheep," he says, "eat the tips of the leaves of the turnips, partially cut off by the scythe; and also the leaves of the charlock, but left the pods and the stalks of the latter in a great measure untouched. Cattle, however, preferred the charlock, eating the whole up clean, before they picked up the turnip leaves. Four or five acres kept about twenty head of young and store cattle near three weeks. Had the food been given to them regularly, and more frugally than it was, it would have kept them sufficiently as store cattle a month. This, added to the saving of the expense, compared with that of drawing, cannot be reckoned at less than twenty shillings an acre."—*Withering's Botany*.—*Loudon's Hortus Britannicus*.—*Sinclair's Weeds of Agriculture*.—*Lawson's Agriculturist's Manual*.—*Mortimer's Husbandry*.—*Lisle's Husbandry*.—*Doyle's Husbandry*.—*Marshall's West of England*.—*Davy's Agricultural Chemistry by Shier*.

CHASE. A tract of ground, devoted to the constant use and the occasional pursuit of certain wild beasts. It differs from a forest, in being less extensive, in having fewer liberties, and in usually belonging to a subject, while a forest can belong only to the crown; and it differs from a park, in its being unenclosed, and in the circumstance that a man may, by prescription, have a chase on another man's grounds as well as on his own. Every forest is a chase, with additional and higher privileges; but no chase, as such, is a forest, or possesses any other protection than such as is afforded by the general laws. The beasts of the chase are the buck, the doe, the fox, the marten, and the roe.—The hunting of wild beasts and of game is commonly called the chase.—A row of shrubby plants is also, in the provincial usage of some places, called a chase. Thus, in the planting of quicksets, a single chase is a single row, and a double chase is another row planted below the first, in the middle of the intermediate spaces.

CHASTE-TREE,—botanically *Vitex*. A genus of ornamental shrubs and trees, of the verberna tribe. The true chaste-tree species, *Vitex Agnus-Castus*, is a hardy deciduous shrub, usually about six feet in height. It is a native of marshy and other moist places of Spain, Italy, and Sicily, and was introduced to Britain, from the last of these countries, in the latter part of the 16th century. Its branches are produced from the bottom and sides of the stem; its bark has a medium colour between brown and grey, but is affected in tint by the character of the soil; its leaves are digitated, or consist of folioles so united on one footstalk at the base as to resemble an open hand; its folioles have a dark green colour, and vary in individual leaves from five to eight, and the longest are situated in the middle, the shortest at the sides; and its flowers have a

bluish purple colour, and are produced in long whorled spikes at the ends of the branches, and bloom in September and October. A variety of this species, with broad and serrated folioles, *Vitex Agnus-Castus latifolia*, is almost as common as the normal plant, and is supposed to have been introduced along with it from Sicily.

The three-leaved species, *Vitex trifolia*, is a native of Ceylon and Hindostan, and was introduced to Britain about the middle of last century. It is an evergreen, purple-flowered shrub, about four feet high, of great beauty, and of considerable reputed medicinal virtue. Its tender shoots and its leaves have a bitter taste and an aromatic fragrance, and are regarded by the Hindoo physicians as powerfully discutient, and are employed, in a warm state, and particularly in the form of fomentations, for rheumatism, swelled testicles, and contractions of the limbs. The bruised leaves are believed by the people of Amboyna to have a powerful effect in healing wounds. The fruit—which is small, smooth, black, and round—is in high repute among the Vytians, for its cephalic and emmenagogue virtues, and is prescribed, in the form of powder, electuary, and decoction, for palsy, weakness of the limbs, and similar diseases.—The cut-leaved species, *Vitex incisa*—called by some botanists *Vitex negundo*—is a tender, evergreen shrub of about four feet in height, and was introduced to Britain from China about the middle of last century. Its leaves are reputed to possess the same medicinal virtues as those of the three-leaved species, but in a less degree; and its root has a bitter taste, and is used, both in infusion and in decoction, in cases of intermittent and typhus fever.—Nine other species, all tender evergreen shrubs or trees, have been introduced to Britain from Ceylon, Cayenne, Hindostan, and Jamaica; two, *V. arborea* and *V. umbrosa*, have each a height of about 30 feet, and the others vary in height from 4 to 8 feet; and one, *V. ovata*, has simple or undivided leaves,—two, *V. umbrosa* and *V. leucorylon*, have quinate digitate leaves like the true Chaste-tree species,—and the others have ternate leaves like *V. trifolia*. Nearly twenty other species are known to botanists.

CHATS. The seeds of the ash, the sycamore, and some other trees.

CHAYA,—botanically *Oldenlandia umbellata*. A low-growing, tropical plant, of the madder tribe. Its leaves are small, white, and numerous, and have a slightly bitter and unpleasant taste; they are prescribed by the physicians of Ceylon and Hindostan, to promote expectorations in diseases of the chest; and, when dried and pounded, they are mixed with flour, and baked into cakes, for the use of asthmatic and consumptive patients. The root is well known and extensively used as a dye-stuff, for dyeing red, orange, and purple; it is produced, in considerable plenty, on the island of Ramissorum, and in the southern parts of the Indian conti-

nent; but the best is grown in the Cingalese province of Jaffna and in the island of Manar. A separate caste of the Cingalese population are distinguished as diggers of this root.

CHEBULA,—botanically *Terminalia Chebula*. An ornamental, medicinal, economical, ever-green, tropical tree, of the combretum tribe. It was introduced to Britain from India in 1796; and it carries whitish-green flowers, and usually grows to the height of about 20 feet. It abounds in Mysore, and in some other parts of India; and is held in much esteem for a considerable variety of uses. Its leaves, when the plant is very young, are employed in some culinary preparations. The whole plant is exceedingly astringent, and contributes its various parts for purposes which require powerful astringent action. It was ascertained by some experiments of Dr. Roxburgh to be more astringent than even Aleppo galls; and when combined in equal proportions with these galls, and with an Indian preparation of the betel-nut, it is considered by the Vytians an excellent external application in aphthous affections of either children or adults. The pulverized flower of the plant is also administered internally as a gentle astringent in bowel complaints. The Chebula is employed in tanning and dressing leather, in producing a yellow dye, and in acting as a mordant to fix many of the colours in Hindoo dye-stuffs.

CHEESE. A well known condimental food, formed principally of the pressed and dried caseum or curd of milk. Cheese and curdled milk appear to have been known and used so long ago as the patriarchal ages of the Hebrew commonwealth. Job says, "Hast thou poured me out as milk, and curdled me like cheese?" Homer speaks of cheese as part of the ample stores which Ulysses and his companions found in the cave of the Cyclops Polyphemus,

"The bending shelves with loads of cheeses prest,
The folded flocks, each separate from the rest."

David was sent by his father Jesse, to "carry ten cheeses to the captain of their thousand in the camp, and to see how his brethren fared." Cheese of kine formed part of the supplies of David's army at Mahanaim, during the rebellion of Absalom. Cheese is mentioned by Euripides, Theocritus, and other early poets. Ludolphus says that excellent cheese and butter were made by the ancient Ethiopians; and Strabo says, "Some of the ancient Britons were so ignorant, that, though they had abundance of milk, they did not understand the art of making cheese." The art of cheese-making was well known to the Romans, and seems to have been introduced by them into both divisions of Great Britain. But all their cheeses appear to have been made without the use of rennet, or simply by allowing the milk slowly to sour, and afterwards pouring off its whey. The art of curdling milk with rennet seems not to date higher in Britain than about the middle of the eighth century; and the prac-

tice of making cheeses of full milk, or otherwise than with skimmed milk, was unknown in Scotland till about the middle of last century.

Cheeses are exceedingly various in consistency, flavour, and other properties, according to the peculiar qualities of the milk, but particularly to the special methods of manufacture. Hard and dried cheeses are adapted and often designed to be long kept; the drier and poorer they are, the longer can they be preserved; and they are by far the most bulky and abundant class of cheeses, and comprise an exceedingly wide range of variety, from the most insipid and leathery skimmed-milk cheese, to the richest and most piquant Cheshire or double Gloucester. Soft and juicy cheeses, such as all cream cheeses, and the luxurious kinds called Bath cheeses and Yorkshire cheeses, cannot be long kept without becoming putrid, and are designed to be sold and used as speedily as possible after they are made. Some varieties, such as the Stilton and the Gruyeres, are intermediate in consistency between the hard and the soft, and possess a medium degree of capacity of preservation. The method of manufacture, especially when regarded as including the control of temperature, and the addition of foreign ingredients, is the grand power in creating and determining varieties,—inasmuch that not only may scores of very perceptibly different varieties be intentionally manufactured in one dairy and one season, from one kind of milk, but very frequently eight or a dozen quite perceptibly different varieties are unintentionally produced from one process, and among one season's set of homogeneous cheeses. "After all that can be done," remarks Mr. Aiton, "cheeses which are made in the same way from the milk of the same cows, and every operation performed alike, will differ considerably in quality and flavour. This diversity is greater in the Scotch than in the English cheese, owing probably to the former being made in ill-constructed houses, and with imperfect apparatus, while in England the dairies are large, the dairy-houses of superior formation, and the operations more uniformly conducted. Milk is more easily contaminated with the slightest impurities than any other substance in common use. It is fortunate that, while there are diversities in the qualities and flavour of cheese, there are also diversities in the taste of its consumers." But before mentioning the characteristics of the chief varieties generally known in the British market, or in the different sections of the British dairy, we must make a brief sketch of the general method of manufacture.

Milk, when exposed for two days or so to the open air, acidifies, and soon after coagulates; and its coagulum, when artificially broken, separates from the larger portion of the serum or whey, and may afterwards, by means of salting and prolonged pressure, be formed into exactly such cheese as seems to have been used by the

ancients. But as this cheese is, in every case, hard, brittle, acrid, and ill-flavoured, means are employed, in all modern cheese-making, for artificially effecting coagulation, and in consequence obtaining sweet curd and agreeably flavoured cheese. Coagulation, with various degrees of rapidity, under various conditions of temperature, and with various results upon the quality of the curd, can be effected by means of alcohol, sugar, acids, supersalts, and the juices of several vegetables; but with no known substance can it be effected with at once superior economy, greater convenience, and more agreeable results, than with the gastric juice or the prepared stomach of calves, hares, poultry, and some other animals. A curd from acidulous coagulation is always more or less sour; one from alcoholic coagulation has a disagreeably vinous gout; and one from coagulation by means of vegetable juices has generally a perceptible flavour of the plants whence the juices are obtained; while a curd from coagulation by rennet, or the juice obtained from the stomach of animals, is quite sweet, and has been found by far the best adapted to the manufacture of all delicately flavoured cheese. Some writers—even in spite of the undoubted coagulating power of alcohol and some other non-acidulous substances—think that acid, in some form or other, is always the coagulating agent, and assert that vegetable acids effect a fuller separation of serum, or produce a greater bulk of curd, than other acids; and they can at least point to the curious facts that a few drops of pure ammonia, put into curdled milk, dissolve the curd, and that soda or potash, though acting with less power than ammonia, so thoroughly decompose curd as to transmute it into a black fatty substance resembling oil. Rennet is prepared very variously, in different districts or by different persons; and Mr. Aiton, alluding to one grand difference between the prevailing English and the prevailing Scotch methods of preparing it, says, "So far from throwing aside the curdled milk found in the stomach of the calves when killed, or washing away the chyle, both are in Scotland carefully preserved, and are found to tend much to strengthen and enrich the rennet. The curdled milk and chyle in the stomach of the calf form more powerful rennet than can be drawn from the bag alone when these substances are removed. It is the chyle formed from the gastric juice, mixed with the food in the stomach of the animal, that forms the coagulating power; and it is only from that chyle, so formed in the stomach, that the bag comes to be impregnated with coagulable matter, more than any other of the intestines of the animal." But the only differential property between the Scotch and the English rennet which at present requires to be noticed, is the important one, that while English rennet usually does not form the curd in less time than from one hour to three hours, Scotch rennet commonly forms it in from five to ten min-

utes. See the article RENNET. A table-spoonful of the best kind of Scotch rennet is sufficient to coagulate thirty gallons of milk; but the proper quantity of any particular specimen of rennet, whether Scotch or English, must necessarily depend on its relative strength; and, as a general rule, it ought, as nearly as possible, to be simply enough to effect perfect coagulation,—for whenever used in excess, as to either strength or quantity, it has a tendency to make the cheese swell, and possibly occasions a sort of smothered fermentation.

A brief notice of the most approved method of making Dunlop cheese, or the best cheese of the Scottish dairies, with a slight occasional reference to some disagreeing points in the English methods, will afford a good view of the proper manufacture of all firm whole-milk cheeses, or of all the best of the hard varieties which are known in the English market; and this may be followed by such separate details as will explain the successful imitation in one district of the best produce of another district, as well as the manufacture of varieties essentially different from the firm whole-milk kinds.

When the milk of the cows of a farm is sufficient to make two cheeses in the day, the produce of each milking, immediately on being obtained, is passed through a sieve, collected in a tub, and subjected to coagulation. But as it is fully and readily coagulable only when near blood heat, and as it suffers considerable cooling before the rennet can be mixed with it, a small quantity of hot water, especially when the weather is cold, may be advantageously added, to raise it to the proper temperature. When two milkings upon a farm are required to make a cheese, the milk of the evening is kept in coolers in the milk-house throughout the night; it is mixed with the milk of the morning, to form one coagulation; and as much of it is artificially heated as is requisite to raise the whole to about blood heat. In some of the English dairies, the cream is skimmed off and heated in order to produce the proper temperature; but this method separates part of the butyraceous matter from the caseum, and occasions it afterwards to pass off in an oily form with the whey. The coagulated milk is cut and very softly turned up, so as to allow the greater portion of the whey to separate; and when the curd is brought to the consistency of butter, it is placed in a drainer, cut into pieces of about two inches square, and subjected to a pressure of 40 or 50 pounds, with a board and weight, in order to squeeze out the remaining whey. Several times during the progress of the consolidation by pressure, at intervals of about a quarter of an hour, the curd is turned over, cut into pieces as before, and subjected anew to pressure. After the whey has quite or nearly ceased to flow by this method, the curd is cut into very small pieces with a peculiarly formed and suitably shaped knife, and is

very thoroughly mixed with a proper proportion of salt, and is then put into the cheese-vat, with a piece of thin canvass around it, and subjected to very heavy or stringent compression. After being compressed for about three hours, and again at every interval of about twelve hours till the cheese is completely made, it is turned out, freed from its damp enwrapping cloth, wrapped in a dry cloth, and placed again under heavy pressure. In some dairies, the cheese, when beginning to cohere, or when taken the second time from under compression, is put for half an hour into a bath of hot water, as warm as the hand of the operator can endure, and is then well dried, wrapped in a cloth, and subjected to a continuance of the compression. The bath is designed to draw out the whey, and accelerate the thorough cohesion of the cheese; but it has been thought by some dairy-farmers to over-soften the cheese at the time, and to render it tough afterwards, and it has nowhere come into general use.

A compression of about 48 hours, in all ordinary circumstances as to the degree of the pressure and the size of the cheese, is sufficient for both the exclusion of the whey and the thorough cohesion of the curd; but this, in any circumstances, can, without injury, be somewhat prolonged. When the cheeses are taken from the press, they are, for three or four days, exposed to the heat of the kitchen or any similar place, and are twice or thrice a-day turned upside down or downside up; and then they are removed to the store-room, there to be turned on every second or third day. In many small dairies, the cheeses are stored on boards along the floor of a garret, or of an attic story, or of a waste room, or of the barn; but in all properly constructed dairies, they are placed on wooden shelves, or on cheese-racks, in store-rooms expressly constructed for the purpose, with shelter from sunshine, with moderate ventilation, and neither damp nor very dry. In Cheshire and Holland, the salting is effected, not as in Scotland by intermixing salt with the curd before going to press, but by means of brine, or by rubbing the cheeses with dry salt after they are taken from press. In many, perhaps most English dairies, under the mistaken notion of enriching or refining the flavour, cheeses, on being removed from pressure, are, in technical phrase, "sweated," or are heated till they exude a portion of their butyraceous matter. Scotch cheeses are never made of the spherical form of the Dutch ones; but are rounded on the edges, and flat on the sides; and most of them have a weight of from 15 to 50 pounds.

In 1824, and again in the following year, the Highland Society offered premiums for the best specimens of Scottish imitations of double Gloucester cheese; and, in pronouncing judgment upon the numerous competing cheeses submitted to them, they were aided by several gentlemen of long and extensive practice in the cheese trade.

On a careful examination of the cheeses of the second of these years, the judges declared, that "the quality of the prize imitation double Gloucester is fully equal to the real cheeses of that variety, and would compete with them in any market;" and they awarded a first premium, both for these cheeses and for imitation Wiltshires, to Mr. Sanderson of Blackcastle, whose account of his mode of making them differs surprisingly little from that which we have given of the prevalent method of making Dunlop cheese. "Not having a sufficient number of cows for making a cheese at one milking," says Mr. Sanderson, "the evening milk, after being skimmed in the morning, and heated to about 104° Fahrenheit, is mixed with the morning milk hot from the cows, and the cream which had been taken off the evening milk also added, the heat of the whole being then 98°. The rennet and colouring are next added, the time of *coming* being from three quarters of an hour to an hour. When sufficiently firm, the curd is gently broken with a scoop, and left for a few minutes to subside; the whey is then taken off, and the curd cut in all directions with a knife. When quite freed from the whey, the curd is cut into square pieces, and put into a drainer, with a cover to fit into the inside. This cover is placed upon the curd, and a 14 lb. weight put on it. Every half hour, it is cut into small pieces, and some additional weight put on. This operation is continued for three hours, when the curd is put into a tub, and cut into very minute pieces, with a knife for the purpose, in shape like the letter S. At this time, the salt is added. The curd is next put into the cheeser or mould, a pretty heavy weight put on it, placed near the fire, and then put into the screw-press. The cows are milked about nine, and the cheese put to press about six; and, while it remains there, a little fine salt is rubbed upon it every time it is turned. The cheeseling, when finally removed from the press, is again rubbed over with salt, which is repeated for ten successive days, during which it ought not to be exposed to much drought. It is next rubbed over with a little fresh butter, and placed in the store-room, where it is turned three times a-week, and rubbed with a coarse towel. The cheeses made in imitation of North Wiltshire, are made exactly as above, only in smaller cheesers. The pine-shaped are put into a cloth, made in the shape of a filtering-bag, when the curd is quite green, and hung, with the point down, for twenty-four hours. They are then put into a net, with a cloth over it, and again suspended the reverse way."

The method of making true double Gloucester cheese, as exemplified in one of the largest and best dairy-farms of Gloucestershire, considerably differs from Mr. Sanderson's method. The curd, after being cautiously, carefully, and well freed from the great body of the whey, is pressed with the hand into vats, covered with fine canvass

cheese-cloths, and placed for half an hour in the press. It is then taken out of the vats, and put into a curd-breaking mill, so constructed as to tear the curd into small crumbs, to save all the laborious toil of squeezing and rubbing it with the hands, and to prevent it from losing any part of its butyraceous matter in the process of pulverization. The minutely divided curd, according to very general though decidedly injurious Gloucestershire practice, is now scalded with hot whey; but, according to the best practice of the county, it is merely pressed compactly together with the hand in the filling of the vat, and is so far rounded up in the centre as to admit of being pressed down to a fair and dense level. "A cheese-cloth is then spread over the vat, and a little hot water is thrown over the cloth, as tending to harden the outsides of the cheese, and prevent it from cracking. The curd is now turned out of the vat into the cloth, and the inside of the vat being washed in whey, the inverted curd, with the cloth around it, is again returned to it; the cloth is then folded over, and the vat put into the press, where it remains about two hours, after which it is taken out and dry cloths applied, which should be repeated in the course of the day; it is then replaced in the press until the cheese is salted, which is generally done within twenty-four hours after it is made. The salting is performed by rubbing the entire of the cheese with finely powdered salt. The cheese is after this returned to the vat, and put under the press, in which more cheeses than one are placed together, care being always taken to put the newest lowest in the press, and the oldest uppermost. The salting is repeated three times, the cloths being removed after the second in order to efface their marks, and twenty-four hours are allowed to intervene between each. Thus, the cheese is within five days taken from the press to the cheese-room; though in damp weather, it should remain somewhat longer. There it is turned every day for a month, when it is ready for cleaning, which is done by scraping with a common knife, the dairy-maid sitting on the floor, and taking the cheese in her lap, to perform the operation. When it has been cleared from all scurf, it is rubbed all over with a woollen cloth dipped in paint made of Indian red or Spanish brown, and small beer; and as soon as the state of the paint will permit, the edge of the cheese, and about an inch on each side, are rubbed hard with a cloth every week."

All the many varieties of whole-milk cheese are made in methods essentially identical, or very nearly so, with the methods we have described. Good sound whole-milk cheese, whatever be the name it wears or the district in which it is made, is firm in consistency, close and even in texture, unctuous to the touch, mild in taste and flavour when new, becoming richer in taste and increasingly mellow with the lapse of a little time, and acquiring a very grateful fragrance and a piquant

gout when it is old. Inferior whole-milk cheese is either flaccid in consistency, loose in texture, harsh in taste, austere in flavour, unequal in colouring, or merging into putrefaction; or it possesses two or more, or possibly all, of these bad properties. Four faults have very generally been ascribed to Scottish whole-milk cheese, as compared with prime Dunlop, or with the best varieties of England,—first, that it is of too soapy a consistency when opened, the curd being disposed in layers, and not cohering into one compact mass,—secondly, that it wants a due degree of consolidation from chemical influence, in consequence, as is alleged, of not having been well and frequently rubbed with salt during the progress and after the close of compression,—thirdly, that it crumbles, like a piece of short-bread or over-baked oaten cake, beneath the application of the knife,—and fourthly, that, even from the same farm, and in the produce of any single season, it is so variable in quality as often to preclude any individual cheese from being regarded as a tolerable specimen of a lot. But these blemishes, so far as they really exist either in the cheeses of Scotland or in those of any district of England, are capable of being prevented by due care in the manufacture.

The cohesion, compactness, and consistency of cheese are determined chiefly by the temperature at which the milk is kept in the coolers and coagulated in the tub; and they may, therefore, be regulated almost at pleasure. When the milk is kept at a lower temperature than 50°, or is coagulated much below blood heat, or is allowed to cool unduly down after the curd is set, the cheese made from it will certainly be both too soft in consistency, and decidedly insipid in taste; and when the curd is formed at a temperature much above blood heat, or is much handled or heated in taking off the whey, the cheese will as certainly be too hard and cohesive. Cracks in cheese have been fancifully supposed by some writers to be occasioned by the liming of the pastures on which the cows are fed; but, in the great majority of instances, they are really occasioned by too early or too great exposure to drought. The running out of whey at the sides, technically called a whey-spring, is prevented in good English cheeses by laborious thrusting and skewering; and yet it rarely occurs in Scotch cheeses which have undergone no more than the ordinary routine of compression. The heaving of cheeses has sometimes been fancifully ascribed to the cows feeding on clover; and though often of obscure and very doubtful origin, it probably arises, in most instances, from electric influence upon the fresh curd, from the presence of a minute portion of gluten or kindred impurity in the milk, or from the use of an overdose of rennet. Rankness of taste may proceed from some putrid matter in the milk, from putrid, ill-preserved rennet, from the contact of putrid air with the milk or the curd, from some

dirty in the dishes, or from the want of due care and speed in squeezing out the whey.

The diversity of taste and flavour which occurs in whole-milk cheese of the same district and even of the same dairy, is, in some respects, difficult to be accounted for, and, in many respects, not easy to be controlled. One known cause is peculiarity in the food of cows. Milk during the period of feeding on turnips is well known to acquire a peculiar flavour from these roots, and to communicate that flavour both to butter and cheese; and it may just as certainly, though unobservedly, acquire a peculiar flavour of a different kind from any one of several weedy herbs which abound in certain pastures. A small quantity of nitre, dissolved in the milk, corrects the turnip flavour; and a small quantity of some other and equally potent substance might be requisite to correct the flavour communicated by particular herbage. Cows, when pastured on dry and steeply hilly ground, abounding in wild herbs, usually yield milk which produces richer and better-coloured butter, than when they are fed on a pasture of artificial grasses.—Another known cause of diversity in the taste and flavour of cheese, is the condition and vicissitudes of the weather. Not only do all the elements of weather control the quality of herbage, and, through its medium affect the health and produce of cows; but heat, cold, sunshine, and especially electricity, powerfully modify the properties of both milk and curd.—A third known cause, and one of great width of range, and diversity of operation, is the exposure of the milk to impure air. One grand reason why much of the cheese of England excels the cheese of Scotland, is simply the comparatively limited operation of this cause in the former country, or the possession on the part of English farmers of far superior appliances of the dairy to those which are generally possessed by the Scotch. While an English dairy has appropriate rooms, and persons wholly devoted to its duties, the Scotch dairy, in multitudes of instances, is merely a nook of the domestic buildings, and shares the attention of only one person in common with the miscellaneous duties of the kitchen. Now, when milk is exposed to many variations of heat and cold, and to many changes and impurities of air,—when it is coagulated in a farmer's kitchen, contemporaneously with processes of cooking, or of cleaning, or of miscellaneous work,—when it is attended to by a servant-of-all-work conjointly or alternately with duties which disturb the temperature or contaminate the air,—and when it is held in dishes, and worked with implements which, at other times, are used for exceedingly different purposes; it cannot possibly maintain either purity or uniformity of flavour, and must unavoidably produce the great diversity of texture, taste, and piquancy which so commonly characterizes the cheese-produce of Scotland.

But even the desirable and sound diversity of

flavour and gout, in whole-milk cheeses, is very great, and, when considered jointly with the caprices of cheese-consumers, occasions insuperable difficulty in finding a precise or even proximate standard of excellence. Good or even prime cheeses differ in taste and flavour according to the dairies, the methods of manufacture, the seasons of the year, the stages of the cows' milk, the state of the weather, the character of the pasture, and some other controlling circumstances. Some fastidious consumers of cheese prefer it new, others prefer it middle-aged, and others prefer it old; some relish the unctuous, some the cohesive, and some the crumbling; some prefer the mild, and others the pungent; some prefer it perfectly sound, others prefer it slightly putrid, and others prefer it in a state of almost thorough decomposition, acrid with empyreumatic oil, stenchy with rottenness, and all alive with a tumbling mass of minute insects. When not only the flavour of good cheese itself is so diversified, but when the taste of its consumers is so exceedingly various, and, in the last instance at least, so monstrously perverse, any final appeal as to pre-eminent quality is manifestly impossible. Yet, in a general way, Scotch cheese may be characterized as less pungent, less acrid, less highly flavoured, milder in the taste, and richer in buty-raceous matter, than English cheese. When a considerable quantity is to be eaten, the Scotch cheese feels less hot and heavy on the stomach; and when only a morsel is eaten, for the sake of its flavour after a good dinner, the English cheese feels more potent and effective in the mouth.

The cheese of Cheshire, and the cheeses of some other districts, are usually stained with annatto, the flowers of marigold, the juice of orange-carrot, or other similar-coloured dyes. See the article ANNATTO. The practice of cheese-colouring was probably commenced under the notion of its giving a highly agreeable tint to cheese; and, in a mercantile sense, it is still in some degree necessary as a popular element or established property of cheeses of certain districts and classes; but, as regards both the profits of the manufacturer and the health of the consumer, it is decidedly pernicious. An Essay written by Mr. Whitley of London, and published in 1841, ably examines the practice, thoroughly denounces it, and shows it to be encumbered with the following among other evils,—that the substances employed in it diminish the comparative quality of curd obtainable from any kind of milk,—that they more or less retard the process of maturation in the cheese,—and that, under the mere name of annatto, they are usually adulterated compounds, decidedly injurious to health.—In some dairies, the leaves of sage, parsley, and other herbs, are infused into cheese, to give it a green colour. In other dairies, part of the curd, when ready for the press, is exposed in a sieve to the air, in order that it may become oxygenated, and

may render the cheese, into which it is mixed with newly prepared curd, of a diversified colour, and of a disposition to run speedily into putridity. In a few dairies, rapid putridity is induced by an intermixture of beaten potatoes. In Ross-shire, cheeses are, for several days, buried within sea-mark, in order that they may acquire a blue colour and a peculiar taste; and in France, a considerable quantity of cheese receives an offensive smell, resembling that of a pig-sty, from an intermixture of fenugreek.

New cheeses require to be gradually dried and slowly hardened before being fit for the market; and, for this purpose, they are usually spread, in a single layer, on the floor or shelves of a cheese-room, store-room, or part of a barn, garret, or dwelling-house, and turned by hand daily, every second day, or twice a-week, in order to alternate the exposure of their surfaces to the air. This, in a large dairy, is a slow and laborious operation; and as it is performed by female servants, it sometimes prevents them from paying due attention to the maintaining of all the dairy and all its implements in a state of perfect cleanliness. Another objection is, that the floor or shelves soon become moist, and in consequence retard the progress of the cheeses' drying. A very effective machine for performing the operation, both with speed, and without retention of moisture, was invented by Mr. Blurton, of Field-Hall, in the vicinity of Uttoxeter, and has been found to combine the four additional advantages, of holding three times as many cheeses as can be laid on the floor of the room which it occupies, of affording shade from sunshine and exposure to a constant current of air over every cheese, of preventing a loss of weight and deterioration of quality from sweating, and of expediting maturity for the market to a degree over the common method of about five weeks in every set of cheeses. The machine is merely a kind of swing-frame, and is not more effective than simple. A dozen strong shelves are framed together, and have bars nailed from the top to the bottom of one side, to prevent the cheeses from falling out in the act of turning; the frame is suspended on two strong pivots, the one set in the wall of the room, and the other supported by a strong post; and two catches keep the frame upright, and prevent it from being turned more than half round. By first filling the shelf immediately above the axis of the frame, and then placing the cheeses alternately on the two nearest shelves above that which has been already filled, the preponderance of the one side over the other can never amount to more than the weight of one cheese; so that the whole power required, in any circumstances, to turn the frame when partially or wholly filled with cheeses, can never be more than is sufficient to overturn one cheese, and to resist the friction of the pivots. The cheeses, in the act of turning, drop on the shelves which, in the former position of the frame, were above them; and the

shelves require to be at such distances as to admit of perfect aeration, and at the same time not to allow space for an injurious depth of fall to the cheeses in turning.

Dunlop cheese began to come into notice during the latter part of last century; it was first manufactured in the district of Cunningham in Ayrshire, and took its name either from the parish of Dunlop, or from a carrier called Dunlop who carried to Glasgow a large portion of its earliest specimens; and it is now made throughout the whole or chief parts of the counties of Ayr, Renfrew, Lanark, Dumfries, Kirkcudbright, and Wigton, and ought, in propriety, to drop the name of Dunlop, and assume the designation of Lowland Scotch. It is far from being so uniform in taste and flavour as some of the best-known kinds of English cheese; but, in the aggregate, it pretty successfully competes with them for popular favour. Part of it is too soft and comparatively insipid; and part has a wide range of both texture and flavour between poor and prime; but a large proportion is firm, solid, sound, fat, and combinedly mild and piquant. Every good specimen of it has a texture like soap and a mellow taste, is free from cracks and fissures, and is neither holed nor open in its pores. It is usually eaten when from one month to ten months old; and not one-twentieth part of it is kept longer than a twelvemonth. When it is allowed to attain comparatively great age, it becomes stronger in taste, though still mild, and acquires a fine rich flavour. The best kinds of it have a closer resemblance to the cheeses of Gloucestershire than to those of any other English district.

Cheshire cheese is not so fat as Dunlop cheese; and it has an austere flavour, a rough, sharp taste, and a dry loose texture, with many small open pores; but it is remarkably uniform in character, and is generally free from cracks and from putrid parts. It is always made with well-trained and routine attention, in well-constructed dairies, according to fixed rules, by one class of persons, and invariably in one way; and hence arises its uniformity. Its curd is formed at too high a temperature, and is broken or churned, by several persons, during about forty minutes, before any portion of the separated whey is poured off, and is bruised or worked, by several operators, during two or three hours before being put to press, and is skewered, during several additional hours, after being subjected to pressure; so that it profusely imbibes the impurities which float in the surrounding air, and undergoes a certain degree of acidulation or oxygenizement, and, in consequence, transfers austereness, acridity, and comparative coarseness to the cheese. The milk of the Cheshire cows, though less in quantity than that of the Scottish breeds, is richer in quality; and it ought to produce a richer cheese; but it is deprived of much of its butyrous matter by excessive heat in the process of coagulation; its curd is deprived of an additional

quantity by excessive manipulation, and by violent breaking and thrusting; and hence the whey is usually so oleaceous as to yield a quantity of butter, and the cheese is proportionally impoverished in all its fatty qualities.

Old Fuller says, respecting the cheeses of Cheshire, "This county doth afford the best cheese for quantity and quality, and yet their cows are not, as in other shires, housed in the winter; so that it may seem strange that the hardiest kine do make the tenderest cheese. Some essayed in vain to make the like in other places, though from thence they fetched both their kine and dairy-maids; it seems they should have fetched their ground too, wherein is surely some occult excellency in this kind, or else so good cheese will not be made: I hear not the like commendation of the butter in this county; and perchance these two commodities are like stars of a different horizon, so that the elevation of the one to eminency is the depression of the other."

Gloucester cheese is characterized by richness of composition, combined piquancy and mildness of flavour, such a waxy texture as permits it to be cut into thin slices without crumbling, and such a retentive diffusion of its oily matter as occasions it, in the process of toasting, to be thoroughly softened without being burned. Its smooth, uniform, waxy texture appears to proceed from proper temperature in coagulation, and from judicious and careful treatment of the curd. Double Gloucester, or what is technically called "the best-making" cheese, ought always, like true Dunlop, to be made of pure unskimmed-milk; but, in some large dairies, it is the produce of two milkings, the one used pure and whole, and the other deprived of sufficient cream and butter to supply the domestic wants of the household. Single Gloucester is very varied in quality, and may either be sheer skimmed-milk cheese, or a manufacture from equal portions of skimmed and unskimmed, or an intermediate article, with its main substance of skimmed-milk, and its qualifying substance of unskimmed. The worst kinds of it are prepared from a milk, deprived to the utmost, and by every kind of effort, of its butyraceous matter. In some Gloucester dairies, the floor of the cheese-room is well rubbed with mint, elder leaves, potato stems, and other herbaceous matter, for the double purpose of giving the cheeses a greenish coat, and of protecting them from mites; and in other dairies, the newly-made cheeses are washed once a fortnight with hot whey, for the purpose of giving them a clean and firm exterior.

Cheddar cheese takes its name from the village of Cheddar, near the Mendip-Hills in Somersetshire; but it is manufactured throughout the whole of the rich midland district of that county, both in its somewhat hilly parts, and in the marshes around Glastonbury. It was, for a considerable time, sold in the London market under the stolen name of double Gloucester, and may be

supposed to have been originally manufactured in imitation of that cheese; but it eventually acquired so great a reputation as to be readily sold, at an equal price, in its own name. The cows are pastured and milked in the vicinity of the dairy; the milk is expeditiously set with the rennet, and allowed to stand two hours undisturbed; a portion of the first separated whey is heated and poured upon the curd, and afterwards all the whey is heated and poured back, and the whole allowed to stand for half an hour; and then the curd is put into the vat, subjected to pressure, and otherwise treated up to maturity in the usual manner. Cheddar cheese is distinguished by a soft, rich, butyraceous appearance and flavour, and is supposed to possess a thorough constitutional intermixture of its particles, and a powerful chemical habit of throwing off such portions of fatty matter as may have a tendency to putrescence.

North Wiltshire cheese often contests celebrity with at once Dunlop, Gloucester, and Cheddar. It was at first, like the Cheddar, an humble imitation of Gloucester; but, also like the Cheddar, it now boasts an independent reputation. "One circumstance," says Mr. Davis, "goes a great way to explain the goodness of the North Wiltshire cheese, namely, the convenient situation of most of the farm-houses in the centre of the farm, so that all the cows can be driven home to milk, and all the milk can be put together of an equal temperature, and, by beginning the work early, the dairyman can make cheese twice in the day." The salt of the North Wiltshire cheese, as of the Dunlop, is intermixed with the curd; the curd is crumbled into very minute pieces, or as nearly as possible pulverized; and the cheeses undergo less pressure, and are usually made of far smaller sizes, than those of other celebrated dairy districts. A frequent method of compression is, to put the curd for each cheese into a filtering-bag, hung with the point downwards, during twenty-four hours, so as to give it the form of a pine-apple, and then to put it into a net, and hang it with the point upwards till it is sufficiently dry. In some dairies, a preparation of green-colouring matter is made with a cold decoction in milk of sage, marigold, and parsley; and a portion of this is mixed with the milk or curd of each cheese-making, in order to give the cheeses a greenish hue.

Stilton cheese is pre-eminently celebrated for richness, high flavour, and exquisite piquancy. It was first manufactured by a relative of the proprietor of the Old Bell Inn at Stilton, in Leicestershire, and took from that place its name, but it is now extensively made throughout the counties of Leicester, Huntingdon, and Cambridge, and in some adjoining districts. It was originally of such choice quality as to be currently sold for half-a-crown a pound, but it is now of diversified quality, in general much deteriorated, and largely of such a kind as to be

sold at a shilling or even tenpence per pound. All good varieties of it are made of the cream of two milkings, and the milk of only one of the two; so that they contain twice as much butyraceous matter as the best of simply whole-milk cheese. The curd is not greatly broken; and the whey is gently removed. All require to be kept during two years, and some during three years, in order to acquire their due or characteristic degree of mellowness and power; and many, it is believed, are kept in moist warm cellars, while others are wrapped in strong brown paper, and plunged into a hotbed. A ready and curious method of inoculating a new Stilton cheese, or a new butyraceous cheese of any kind, with the flavour of one which has become old, mellow, and incipiently putrid, was communicated to the secretary of the Highland Society, in 1832, by Mr. Robison, the secretary of the Royal Society of Edinburgh. "This," says Mr. Robison, "may be done by the insertion in the new cheese of portions of the old one containing blue mould. The little scoop which is used in taking samples of cheese, is a ready means of performing the operation, by interchanging ten or a dozen of the rolls which it extracts, and placing them so as to disseminate the germ of the blue mould all over the cheese. A new Stilton cheese treated in this way, and well covered up from the air for a few weeks, becomes thoroughly impregnated with the mould, and generally with a flavour hardly to be distinguished from the old one. In selecting cheeses for this operation, I have chosen them dry, and free from any unpleasant taste; and I have never failed in obtaining a good result, although sometimes, when the old cheese had decayed matter mixed with the blue mould, the flavour and appearance of the inoculated cheese differed a good deal from that of the parent one. I have sometimes treated half a Lanarkshire cheese in this way, and have left the other half in its natural state; and have been much amused with the remarks of my friends on the striking superiority of the English cheese over the Scotch one."

Parmesan cheese, though reported to be made of skimmed-milk, has so decidedly an oleaceous character, and possesses so piquant a taste, and sells in London at so extravagantly high a price, that it must be placed in the same category with whole-milk cheeses. It is made not only in the little Italian state whence it takes its name, but throughout the luxuriant district of the Milanese situated between Lodi and Cremona. The milk for it is drawn from cows which are stall-fed on hay throughout the winter, and on cut grass throughout the summer; and each cheese of it has usually a weight of between 60 and 180 lbs., and is produced by a group of dairymen, on a sort of joint-stock plan of association. The milk for a prime cheese of it is a mixture of the evening's milking skimmed in the morning and at noon, and of the morning's milking skimmed at noon. This is gradually heated to a temperature

of about 120°, in a large copper caldron, shaped like an inverted bell, and so suspended on the arm of a lever as to be removable off and on the fire at pleasure; it is then taken from the fire, set with the rennet, and allowed about an hour to coagulate; and it is next put anew upon the fire, gradually raised to a temperature of 145°, and incessantly and briskly stirred till all the curd separates into small pieces. Part of the whey is first taken out, and a little saffron put in for colouring; and when the whole of the curd is thoroughly broken, almost all the whey is taken out, and a sufficient quantity of water poured in to enable the operator to bear the heat with his hand. The curd is now collected, by means of a cloth passed beneath it, and gathered up at the corners; it is pressed into a wooden frame on a platform, and covered with a piece of wood and a very heavy weight; and, during one night, it throws off most of its contained whey, and acquires a firm consistence. During forty days, it is daily turned, and has its uppermost side rubbed with salt, so that each side receives twenty saltings; and after the termination of the forty days, its outer crust is pared off, its fresh surface is varnished with linseed oil, and its convex side is coloured red. A strong suspicion very generally exists that the fatty or oleaceous matter which fills the pores of Parmesan cheese originates in the mixing of rape oil, olive oil, or hog's lard with the curd. A Parmesan cheese, at all events, in spite of being professedly made of mere skimmed-milk, is the fattest, as well as the most pungent and acrid-flavoured variety of cheese in popular favour; and its fat has far more the appearance of oil or of hog's lard, than of butyraceous matter or richly creamy milk.

The skimmed-milk cheeses of Britain are exceedingly various in quality, partly from the same causes which control the quality of whole-milk cheeses, but chiefly from the degrees of deprivation of cream which are practised upon the milk. One, two, or three creamings may be taken; or the milk may stand through very various periods, and under very various conditions, so that the resulting degrees of richness or poverty in the cheese may be numerous and wide. If but little cream be taken away, the cheese may be only one degree inferior to Dunlop or double Gloucester, and if the whole be taken away, it may be a hard, coriaceous, indigestible mass of mere caseum, not fit for the use of a human being, and requiring rather to be chopped with a hatchet than cut with a knife. The skimmed-milk cheese of Suffolk, Tweeddale, and some other districts of England and Scotland, where better things might be expected, is so dismally bad as to serve chiefly for exercising the teeth and jaws, and testing the power of the stomach; and that not long ago in general use among the Scottish peasantry was so vilely manufactured as to be an absolute abomination. "It

is only of late years," remarks Mr. Aiton, "that due attention began to be paid in Scotland to cleanliness. Till of late, the operations of the dairy were carried on in the sooty and dirty hovels which were then inhabited by the tenants; and the housewife, while she was sinking her arms to the elbows in the milk or curd, was alternately cooking for the family, and"—but the rest of the sentence is too disgusting to be quoted. "But a separate dairy-house is now common in the generality of farms; and the person who sets the curd, &c., does nothing else till the cheese is put under pressure." Milk for skimmed-milk cheese should be put into three-inch or four-inch coolers, and allowed to stand between 24 and 48 hours; it should afterwards, without any delay, be freed from its cream, and manufactured into cheese; and it should be heated to about the temperature of the blood, and passed through a sieve into the curd-vat, there to be coagulated. The subsequent operations are the same as for whole-milk cheese, but give less trouble, and require less nicety of care.

Dutch cheeses, under the names of Gouda, Friezland, Eidam, and other designations, are extensively imported into Britain; and are of very various quality, both whole-milk and skimmed-milk, some hard, poor, and exceedingly cheap, and others good, piquant, and expensive. The Gouda has the highest reputation, and seems to be peculiarly prepared. A method of imitating and even excelling Gouda cheese was published in a French Agricultural Journal in 1830, and deserves the consideration of British dairy-farmers. The rennet is prepared by digesting, during three weeks, six gastric pieces, cut small, in three kilogrammes of water, five kilogrammes of common salt, two ounces of saltpetre, and half a bottle of vinegar of wine. The milk for any one cheese is all of one milking; and it is put into a plain, unpainted, wooden trough, and coagulated either at its own natural heat, or with the aid of some heat imparted to the trough, or, in the case of very rich pasturing, by the addition of a very little warm water. When the rennet is added, the milk is very gently stirred; when the curd begins to form, the whey is gradually poured off; and when the great body of the whey is discharged, the curd is carefully and thoroughly kneaded into one homogeneous mass, and wrapped in a thin linen cloth of a fine but strong texture, and put into a frame, whose sides are pierced with small holes to permit the free and constant exclusion of the expressed whey. When the cheese is placed under the press, it receives pressure at first but lightly, and afterwards by slowly increasing degrees; it is allowed to remain during a vastly shorter period than in the English methods,—shorter even than in the common Dutch methods, and not so long in hot weather as in cold; and when removed from the press, it is floated during five or six days in a pickle strong enough to float an egg, and has its upper surface,

during the whole of that period, covered with a somewhat thick layer of salt.

The Swiss cheeses, like those of Holland, are various in quality, some hard and coriaceous, and others soft and butyraceous,—some made chiefly or altogether of whole-milk, some of skimmed-milk, and some of curious combinations of milk, potatoes, and meal. The Gruyeres or Jura cheese has obtained a factitious fame among certain British gourmands, and yet is really a hard, coriaceous, bluish, half-insipid mass of skimmed-milk curd, requiring a coat of butter to make it palatable, and usually washed down by the mountaineer peasantry with a draught of fresh or of fermented whey. It seems to be really prepared in the manner in which the Parmesan cheese is professedly prepared,—by joint-stock management, and wholly of skimmed-milk; but it possesses none of the surreptitious fattiness and pungency of the Parmesan, and ought to be considered, less as cheese, than as hard, exsiccated, sodden curd.—The green cheese called Schabzieger, and made in the canton of Glarus, is a curious and nasty preparation, and, similarly to the Gruyeres cheese, though quite different from it in nature, has acquired an unaccountable and absurd celebrity. The curd for it is freed from the whey by pressure in perforated boxes; it is kept in masses till it begins to putrefy; it is then worked into a paste, and has its putrefaction arrested, with a large proportion of the common, aromatic, trefoil, annual weed, *Melilotus officinalis*, in a dried and pulverized condition; and it is finally pressed into moulds shaped like common flower-pots, and left there to consolidate and harden.

Cream-cheeses are luxuries, of delicate character, and requiring nice management; and some are strictly extemporaneous preparations, while none can be long kept. The cream-cheeses of Neufchatel consist simply of cream thickened by heat and pressed in a small mould; and they rapidly become first sour and then mellow, and are usually imported from France as luxuries, and eaten in their mellowed condition.—The cream for the best cream-cheeses of Britain is dried in small vessels of about an inch and a half in depth, with perforated bottoms, such as retain the cream and allow milk to escape; it is so covered with rushes or the culms of maize, as to be capable of being turned without being directly touched; it receives no other compression than with the hands, between cloths; and it is kept in a temperature, as nearly as possible uniform, and neither cold nor very hot, till it evaporate and become mellow.—An extemporaneous cream-cheese may be made as follows:—"Warm a pint of cream; add one spoonful of rennet; let it stand during an hour; put it into a sieve, first laying a thick cloth into it; let it stand during twenty-four hours; and then put it into a cream-vat, and cover it with a wet napkin and a board. If the process be commenced so early in the morning as about five o'clock, two spoonfuls of rennet may

be added, and the cream may stand an hour, then be put into a sieve, then stand three hours, then have the edges drawn as it thickens, and finally be put into a vat about an hour before it is wanted."

A recipe for a kind of cheese in perfect contrast to the luxury of cream-cheeses, but capable of important use in the economy of cottier-farmers—cheese from butter-milk—is given by a correspondent in the *Quarterly Journal of Agriculture* for October 1843. The writer obtained the recipe in Long Island, in the United States, and recommends it especially to the attention of Scottish farmers. "The contents of my churn," says the writer, "I put into a pot, which I hung over a slow fire. The butter-milk curdled; and the curd sunk to the bottom of the pot. I then poured off the whey, and worked the curd as I would do other cheese, giving it salt to the taste, which was about half the quantity given to skim-milk curd. The curd was then put in a clean coarse linen cloth, tied tight, and hung from the ceiling to dry for a few weeks, when the cheese was fit for use. The linen cloth, when hung in a net, gives a neatness to the appearance of the cheese. If a little bit of butter be worked into the curd, and the cheese kept for three or four months, it will then be very good. I used to buy small cheeses in the market of New York, which I expected would be like Scotch skim-milk cheese; but on finding them to taste like ewe-milk cheese, I was informed they were made from butter-milk."

Ewe-milk cheese, either wholly from ewe-milk, or from a mixture of ewe-milk and cows'-milk, was at one time extensively manufactured in Britain, and is still extensively manufactured in many districts of continental Europe. But, though much relished by some persons, it has ceased to be much esteemed in either England or Lowland Scotland; and, with very few exceptions, is now made only in remote and mutually distant spots of Wales and the Scottish Highlands. The writer of a long article on Perthshire Husbandry in the *Farmer's Magazine*, asserts, that the peculiar, pungent, aromatic flavour which originated and temporarily maintained the celebrity of ewe-milk cheese, was derived from the intermixture of the grossest impurities in the act of milking.—Goat-milk cheese was also, for some time, in vogue; but it has shared the fate of ewe-milk cheese; and it probably owed its temporary celebrity to a very similar cause.

Cheese is manufactured from potatoes and curdled milk in Thuringia and part of Saxony, and is said to be of very fine quality. A brief notice of the method of making it appeared in a French periodical in 1829, and is thrice copied into the *Quarterly Journal of Agriculture*, in respectively 1831, 1838, and 1842. "After having collected a quantity of potatoes of good quality, giving the preference to the large white kind," says this notice, "they are boiled in a caldron; and after

becoming cool, they are peeled and reduced to a pulp, either by means of a grater or a mortar. To five pounds of this pulp, which ought to be as equal as possible, is added a pound of sour milk, and the necessary quantity of salt. The whole is kneaded together, and the mixture covered up and allowed to remain for three or four days, according to the season. At the end of this time, it is kneaded again, and the cheeses placed in little baskets, where the superfluous moisture is allowed to escape. They are then allowed to dry in the shade, and placed in layers in large pots or vessels, where they must remain for fifteen days. The older these cheeses are, the more their quality improves. Three kinds of them are made; the first, which is the most common, is made according to the proportions above indicated; the second, with four parts of potatoes, and two parts of curdled milk; the third, with two parts of potatoes, and four parts of cow or ewe milk. These cheeses have this advantage over every other kind, that they do not engender worms, and keep fresh for a great number of years, provided they are placed in a dry situation, and in well-closed vessels." See the articles *CASEUM*, *CHEESE-PRESS*, *CHEESE-MAGGOT*, *MILK*, *WHEY*, *RENNET*, *COW*, and *DAIRY*.—*Aiton's Treatise on Dairy-Husbandry*.—*Whitley's Essay on Cheese-Colouring*.—*Holland's Agriculture of Cheshire*.—*Fuller's Worthies*.—*Davis' Survey of Wiltshire*.—*Communications to the Board of Agriculture*.—*The Bath Papers*.—*The Farmer's Magazine*.—*The Quarterly Journal of Agriculture*.—*Transactions of the Highland Society*.—*The Magazine of Domestic Economy*.—*Hunter's Georgical Essays*.—*Marshall's County Reports*.—*Rham's Book of the Farm*.—*Knowledge Society's Farmer's Series*.

CHEESE-CLOTHS. Large napkins or towels for enveloping the cheese-curd, preventing its immediate contact with the cheese-vat, and imbibing its expressions of whey, during the process of consolidation in the cheese-press. Many are of home-manufacture; and all should be strong, bibulous, of open texture, and of linen fabric.

CHEESE-FLY. See *CHEESE-MAGGOT*.

CHEESE-KNIFE. See *CHEESE*.

CHEESE-LIP. A bag in which dairywomen prepare and keep rennet.

CHEESE-MAGGOT. The larva of a species of dipterous insect, of the *piophilæ* genus. This genus comprises five or six known British species. Its antennæ are three-jointed, and are inserted in a cavity in the front of the face; its two palpi are fleshy, clavate, and pubescent; its lip is large and fleshy; its head is nearly globose; its eyes are remote and rather small; its thorax is nearly quadrate; its scutellum is triangular; and its wings are transparent, and have about twelve perfect cells. The species which produces the cheese-maggot, *Piophilæ casei*, is about two lines in length; its body is greenish-black, smooth, and shining; the front of its head is reddish-ycl

low; its thighs, at the base and the apex, are ochreous yellow; its tibiae are deeply ochreous; its anterior tarsi are black, and the others ochreous; and its wings are clear, iridescent, and slightly tinged at the base with rust-colour. The female, by means of her ovipositor, places her eggs deep in the holes and fissures of cheese. The larva, cheese-maggot, hopper, or jumper, is pale, somewhat transparent, and free from hairs; and it has, in front, two strong mandibles resembling claws, and, in rear, some projecting points which enable it to vindicate its popular name of jumper. "These maggots," says Kirby and Spence's Introduction to Entomology, "have long been celebrated for their saltatorial powers. They effect their tremendous leaps—laugh not at the term, for they are truly so when compared with what human force and agility can accomplish—in nearly the same manner as salmon are stated to do, when they wish to pass over a cataract, by taking their tail in their mouth, and letting it go suddenly. When it prepares to leap, our larva first erects itself upon its anus, and then, bending itself into a circle by bringing its head to its tail, it pushes forth its unguiform mandibles, and fixes them in two cavities in its anal tubercles. All being thus prepared, it next contracts its body into an oblong, so that the two halves are parallel to each other. This done, it lets go its hold with so violent a jerk, that the sound produced by its mandibles can be readily heard, and the leap takes place. Swammerdam saw one, whose length did not exceed the fourth part of an inch, jump in this manner out of a box six inches deep; which is as if a man, six feet high, should raise himself in the air by jumping 144 feet." When cheese-maggots are numerous in a cheese, they rapidly destroy it, both by crumbling it into minute particles, and by shedding upon it a corrosive and putrefying liquid; but they may easily be destroyed, either by exposing it to a pretty strong heat, or by plunging it in such a medicated bath as will kill them without altering its own substance or flavour.

CHEESE-MITE. A very minute apterous insect, of the *acar*us genus. It is so small as to be very nearly microscopic; it accumulates, in great multitudes, upon dry decayed cheeses; and, by an extraordinary perversity of taste, it constitutes, in the estimation of many gourmands, a grand recommendation of the putrid caseous masses which it overruns and inhabits. How it gets into cheeses, is not known. A colony of it, as seen through a powerful microscope, are interesting objects of both curious and scientific observation; but how they can be pleasant subjects of human mastication, or desirable tenants of the human stomach, none but gourmands are able to conceive. An eminently disgusting circumstance is, that their excrements constitute the fine brown powder which the eaters of decayed cheese so particularly relish. A cheese-mite has eight legs; and between two claws, on

the foremost four of these, is a long-necked vesicle which possesses great capacity of inflation and contraction. When the mite sets down its foot, the vesicle inflates; and when the creature lifts up its foot, the vesicle contracts.

CHEESE-PRESS. A machine for effecting the compression of cheeses, and forcing from them the remains of their whey while in the cheese-vat. A great evil, in the simplest and most primitive cheese-presses, is the imposing of sudden, forcible, and maximum pressure, and the consequent forcing out of portions of fatty juice, the retention of which adds both richness of flavour and highness of price; and a considerable evil, in even some of the newer and more improved machines, is the unequal distribution of the pressure, and the consequent want of uniformity in the texture of the cheese. The varieties of cheese-presses are very numerous; and some of these varieties are in extensive use; but all, the ancient as well as the modern, may be satisfactorily referred to five types.

The simplest and oldest kind of cheese-press is a long timber lever, so adjusted as either to impose the weight direct upon the cheese-vat, or to let the latter be placed between the weight and the fulcrum. The end of the lever—in modes of adjustment which may still be seen exemplified upon cottier-farms, or the farms of remote districts—is fixed sometimes in a hole in the wall, sometimes to a bolt, and sometimes in the trunk of a tree; and the sinker forms the fulcrum, while two or three undressed stones, placed on the other end of the lever, constitute the weight.

A second kind of cheese-press has a large square stone suspended by a screw, between the side-posts of a timber-frame. The cheese-vat is placed directly beneath the stone; and the latter is lowered upon the sinker, or returned to its former position, by respectively the turning and the re-turning of the screw. During the intervals of the machine being used, a small block of timber is placed beneath the stone, to sustain its weight, and to prevent the screw from being strained. This kind of cheese-press may, by good management, be so constructed as to effect both equal and graduated pressure; but, in general, it imposes the whole weight at once, and is considerably liable to make an over-pressure on one side.

A third kind of cheese-press consists of two perpendicular side-posts, a fixed cross-beam on the top, a moveable cross-beam parallel to that on the top, and two screws suspending the latter beam upon the former, and working it up or down as required. The cheese-vat is placed upon the lower beam, and screwed up into compression against the upper beam. This mechanism may seem to secure graduation and equal diffusion of pressure; but it can rarely, if ever, be depended on for perfect working throughout any considerable period, and must be regarded as very little superior to the second kind.



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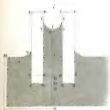
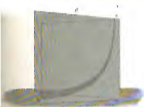
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A fourth kind of cheese-press consists of a frame of cast-iron; a fixed iron-plate for receiving and retaining the cheese-vat; a moveable iron-plate for pressing upon the sinker of the cheese-vat; a perpendicular piston fixed into the moveable plate, and provided over its middle and upper part with a rack; a pinion and ratchet-wheel, for working in the rack, and elevating or lowering the piston; a malleable iron lever, three feet in length, and grooved in several places on the upper side, to hold the ring of the weight, and to lessen or augment the power of the machine in the proportion of the weight's distance from the ratchet-wheel; and a winch-handle, on the side opposite to the iron lever, to turn the axis of the pinion, and apply the whole power of the machine. This press—of which, as made by the Shott's Iron Company, a drawing is given in *Plate XV., Fig. 8*—is exceedingly effective, and possesses the advantage of giving any amount of pressure which may be required, and of applying this either quickly and easily, or slowly and more powerfully to suit the conclusion of the operation.

A fifth kind of cheese-press is known by the epithet pneumatic, and was invented in 1833 by Sir John Robison. "This," says the brief notice of it in the Catalogue of the Highland Society's Museum, "is an ingenious and successful application of science to a homely process. The curd, which is to be freed of its whey, is put into the form upon a permeable bottom. The air-pump is then worked to produce a partial vacuum in the receiver, when the atmospherical pressure, acting on the curd, exerts a gentle and uniform force, which causes the whey to descend into the recipient below. Cheese prepared by this process is found to be superior to any made in the common way."—*Doyle's Husbandry*.—*Low's Elements of Agriculture*.—*Transactions of the Highland Society*.—*Catalogue of the Highland Society's Museum*.—*The Quarterly Journal of Agriculture*.

CHEESE-RACK. A swing-frame for drying and turning cheeses. See the article **CHEESE**.

CHEESE-RENNET. See **BEDSTRAW** and **RENNET**.

CHEESE-VAT, or CHESSEL. The vessel for containing the prepared curd during the process of its compression into cheese in the cheese-press. Its size and form necessarily vary according to the desired size and form of the cheese. The common cheese-vat is a very strong miniature tub, with little or no interior taper, built in staves of elm, and very strongly hooped. Its bottom is thick, and is pierced with holes to permit the escape of the expressed whey; and its top is exactly fitted with a strong, cross-doubled, wooden cover. The cheese-vat commonly used in Cheshire and some other districts, is made of tin.

CHEIMATOBIA. See **MOTH**.

CHEIRANTHUS. See **WALLFLOWER**.

CHEIROSTEMON. An interesting and beautiful tropical tree, of the bombax tribe. It con-

stitutes a genus of itself, and takes for its specific designation *platanoides*. Its generic name alludes to the resemblance of its stamens to the human hand; and its specific name alludes to the similarity of its growth and appearance to those of the plane-tree. Its popular name, so far as it has one, alludes also to the form of its stamens, and, in the language of its native country, signifies 'the hand-tree.' Its full-grown stem is about the thickness of a man's body, and about the height of 30 feet; its branches are numerous, close, and horizontal, constitute in the aggregate an imposing compact head, and are beset, toward their extremity, with a profusion of short, fawn-coloured hairs; its leaves are cordate, serrated, slightly seven-lobed, richly green above, fawn-coloured hairy below, and six or eight inches long; its flowers appear at the ends of the branches, and, though apetalous, have a large, bright red, fleshy, angular, five-lobed, campanulate calyx, and a very curious and imposing set of stamens, forming combinedly a column, and forking at the top into five processes similarly disposed to the parted and curved fingers of the human hand; and its fruit is a large, five-celled, woody capsule, containing in each cell from 15 to 20 seeds. A single tree of *Cheirostemon*, near the town of Toluca in Mexico, has long been held in superstitious veneration by the Mexicans, and, till of late, was generally believed by them to be the only individual of its species in existence, and appears to be much older than the date of the conquest of America. But the plant was propagated from cuttings in the Botanic Garden of Mexico in 1801; it was introduced to Britain from New Spain in 1820; it has now become not uncommon in our hothouse collections; and it is known to grow abundantly in the native forests of Guatemala.

CHELIDONIUM. See **CELANDINE**.

CHELONE. A genus of very beautiful herbaceous plants, of the figwort tribe. Six species, all perennial-rooted, and five of them quite hardy, have been introduced to Britain from various parts of North America; and one of them grows to the height of about 7 feet, and each of the others to the height of about 4 feet. The smooth species, *Chelone glabra*, though far from being the prettiest, is the longest and best known, and was introduced in 1730. Its root is decurrent and thick-jointed; its stems are smooth and channelled; its leaves are produced in sessile and opposite pairs at the joints, and are $3\frac{1}{2}$ inches long, and about three-quarters of an inch broad at the base, and diminish gradually in breadth from the base to a point at the top; its flowers are white, monopetalous, tubular, very similar in shape to the flowers of foxglove, and appear from August till October; and its fruit is an oval capsule, full of white, roundish, compressed seeds. The colours of the flowers of the other species are purple, scarlet, pale red, and combinations of scarlet and orange. Eight or nine species of the

handsome and well-known genus pentstemon are assigned by some botanists to the genus chenone.

CHENOPODIUM,—popularly *Goosefoot*. A large genus of apetalous plants, forming the type of the natural order chenopodiæ or chenopodiaceæ. The genus itself will be noticed under the word *GOOSEFOOT*. The order chenopodiæ comprises within Great Britain, either as weeds or as cultivated plants, about 160 hardy herbaceous species, 6 or 7 hardy ligneous species, about 30 greenhouse species, and 8 or 9 hothouse species; and these are distributed among the genera chenopodium, salsola, atriplex, blitum, beta, spinacea, ceratocarpus, salicornia, galenia, and thirteen others. All the species have small, green, herbaceous, apetalous flowers, a small number of stamens, one-celled membranous fruit, and soft, succulent, unstipulate leaves. They differ from the species of Amarantaceæ in not having their flowers coloured and enveloped in membranous bracts, and from those of Polygonaceæ and Urticæ in not having any stipules; but they are distinguishable from all, and especially from Amarantaceæ, much more by their habit than by any artificial character. Some have a fetid smell; almost all have a coarse, rank, weedy appearance; very few can be regarded as, even in a subordinate sense, ornamental plants; and a remarkably large number are useful for some one or other of many economical purposes. The roots of the beets are cultivated for boiling, for pickling, and for the manufacture of sugar; the leaves of the beets are esteemed as esculents and for forage; the leaves of spinaceæ and of many chenopodiums are eaten as spinach; the Quinoa plant is said to be as important to the Peruvians as wheat, maize, and potatoes are to Europeans; the salsolas, the salicornias, the anabases, the salt-marsh chenopodiums, and many species of atriplex, yield a very large produce of soda; one chenopodium is a vermifuge; several chenopodiums are tonics and antispasmodics; one atriplex is an emetic; and not one species of the order, so far as is known, possesses any deleterious property. The Chenopodeæ are thus remarkable for combining nastiness of habitat and ugliness of appearance, with an extraordinary amount and diversified range of utility.

CHERIMOYER,—botanically *Anona Cherimolia*. A tropical fruit-tree, of the same genus as the custard apple. It is a native of Peru, and of other parts of tropical South America, and was introduced to Britain in 1739. Its stem is lofty and massive in its native country, but seldom grows higher than between 12 and 18 feet in Britain; its leaves are large, bright green, oval, and pointed at both ends; its flowers are solitary, brown, and fragrant, and appear in July and August; its fruit is oblong, scaly on the outside, of a dark purple colour when ripe; and the flesh of its fruit is white, soft, sweet, mixed with several coffee-coloured seeds, and held in higher

esteem by the Creoles of Peru than that of any other fruit of their country.

CHERLERIA. A genus of ornamental plants, of the carnation tribe. The sedum-like species, *C. sedoides*, is a herbaceous, low-growing, perennial-rooted native of the mountains of the Scottish Highlands. Its flower has a yellow and white colour, and appears in July and August. Five other species are known.

CHERRY (BIRD). See *BIRD-CHERRY*.

CHERRY-LAUREL. See *LAUREL*.

CHERRY-TREE,—botanically *Cerasus*. A genus of fruit and ornamental trees, of the rosaceous-flowered tribe. A general view of the genus is given under the word *CERASUS*; and two or three prominent species, including a number of varieties, will be found noticed in the articles *BIRD-CHERRY* and *LAUREL*. We shall notice, in the present article, only a few of the species which are more strictly known as cherry-trees; and then take a comprehensive view of the varieties and economy of such cherry-trees as are cultivated for their fruit.

The Mahaleb, or perfumed cherry-tree, *Cerasus Mahaleb*, is a native of Austria, Switzerland, and the north of Europe, and was introduced from the first of these countries to Britain in 1714. It is a handsome small tree, and has a frequent place in shrubberies and parks as an ornamental plant, but does not rank as a cultivated fruit-tree. Its stem usually attains a height of between 10 and 20 feet; its branches are covered with a smooth, whitish-grey bark; its leaves are small, oval, and lucid green, and stand alternately on the branches; and its flowers are white, and bloom in April and May. Its fruit is greedily eaten by birds; and its timber always emits an agreeable fragrance, and is much esteemed by cabinet-makers, particularly in France. The timber, and not any property of the living plant, is alluded to in the popular name of "perfumed cherry-tree."—Two thoroughly established varieties of the Mahaleb are now well known in the public nurseries, and recognised by systematic botany,—the yellow-fruited, *C. M. fructu-flavo*,—and the broad-leaved, *C. M. latifolia*.

The ground cherry-tree, *Cerasus chamaecerasus*, is a native of central and eastern Europe, and was introduced to Britain from Austria near the close of the 16th century. It is a deciduous shrub, of from 4 to 8 or 9 feet in height; and is cultivated solely for ornament. Its branches are numerous and horizontal, and they spread out on all sides, and are very subject to droop to the ground, and there strike root in the manner of stolons or layers; its leaves are long, narrow, entire, very smooth, similar in appearance to the leaves of some kinds of willows, light-green above, and bluish or sea-green below; its flowers are shaped like those of the common cherry, but are smaller, and grow on slender footstalks, in groups of two, three, or four, from the joints of the branches; and its fruit resembles that of the

small wild cherry-tree, but has a bitterish flavour.—The dwarf species, *Cerasus pumila*, introduced from North America about the middle of last century, is closely similar in appearance and habit to the ground-cherry, but seldom attains more than one-fourth of its height.—The prostrate cherry-tree, *Cerasus prostrata*, introduced in 1802 from Crete, is a slightly tender, quite procumbent, pink-flowered, ornamental plant, of seldom more than about a foot in height.—The Japan cherry-tree, *Cerasus japonica*, introduced in 1810 from Japan, is a very handsome, low-growing, pink-flowered shrub, of usually between two and four feet in height; and it comprises a normal variety, a double variety, and a Chinese variety,—the second called *C. j. multiplex*, and the third introduced about 12 years ago, and frequently confounded with the normal plant.—The pigmy cherry-tree, *Cerasus pygmaea*, introduced about 24 years ago from North America, is an ornamental shrub of seldom more than 4 feet in height.—Several other species, particularly the peach-leaved, the depressed, the winter black choke, and the Chicasaw plum, are small, ornamental shrubs,—all, like the common cherry-tree, carrying white flowers about the end of spring.

The bird's corone cherry-tree, *Cerasus avium*, is a large, deciduous, native timber and fruit tree of England and of northern continental Europe. Its stem is massive, and commonly soars to the height of about 50 feet; its branches are so numerous, spreading, and relatively adjusted, as to constitute a very noble dendritic head; its leaves have an ovately lanceolate outline, and are downy underneath; its flowers are produced, in sessile umbels, from the sides of the branches, and appear rather later than those of the cultivated cherry-trees; and its fruit is small and red, and ripens late in autumn. Trees of this species are very elegant in the forest; yet they are seldom or never planted by the proprietor, partly because they readily propagate themselves, and partly because their fruit offers a powerful temptation to children to break the branches of the trees, and damage the surrounding grounds. The wild cherry grows well on either prime soil or exceedingly bad soil; but it attains its largest size, and bears its greatest loads of fruit, on a loamy soil incumbent upon a fine sandy gravel. Its timber has a fine grain, and a colour somewhat resembling that of mahogany; and it is held in much esteem by our cabinet-makers, and is extensively used for doors, window-shutters, and various articles of furniture.—Three varieties of this species are cultivated for their fruit, or as grafting stocks of fine cultivated varieties, or as types whence some of these varieties have sprung,—the common wild, *C. a. sylvestris*, a native of the woods of Britain, usually about 50 feet high,—the long purple-fruited, *C. a. macrocarpa*, a native of Switzerland, usually about 50 feet high,—and the pale or white and red fruited, *C. a. pal-*

lida, also a native of Switzerland, usually about 20 feet high. A double-flowered and merely ornamental variety, *C. a. multiplex*, is likewise well known in shrubberies and parks, but seldom attains a height of more than 15 or 16 feet.

The common cherry-tree, or aggregate type of the numerous varieties which, additional to those of the bird's corone cherry-tree, are cultivated for their fruit, may be regarded as constituting either one species or four species,—one, under the name of *Cerasus vulgaris*, or four, under the names of *C. semperflorens*, *C. Juliana*, *C. duracina*, and *C. caproniana*. One of its varieties, bearing a black-coloured fruit, grows wild in England, and competes with *C. avium* in the utility of its timber, and has sometimes been regarded as the type of the whole group. But all the four divisions, or four species, may be summarily regarded as natives of almost all the milder parts of Europe, and as, for the most part, attaining a height of about 20 feet; and though they possess very discernible properties of mutual distinction, not only from one another, but in each of their numerous varieties, they aggregately constitute an object too well known to require any description, and too full of beauty in at once foliage, flower, and fruit, to escape the observation of any of our population except babes and idiots. "Were cherry-trees scarce, and with much difficulty propagated," remarks Hanbury, "every man, though possessed of a single tree only, would look upon it as a treasure. For, besides the charming appearance these trees have, when besnowed, as it were, all over with bloom in the spring, can any tree in the vegetable tribe be conceived more beautiful, striking, and grand than a well-grown and healthy cherry-tree, at that period when the fruit is ripe?" The double-flowered variety of the wild species, *C. avium multiplex*, and the thoroughly double-flowered variety of the hautbois species, *C. caproniana multiplex*, are especially and even most brilliantly beautiful. The flowers are produced in large and noble clusters; and all are very large, and as double as garden roses; and they stand on long and slender footstalks, so as to give the branches an appearance of being sheeted over with beauty, and yet possessing an air of ease and freedom. "They are of a pure white," remarks Marshall, "and the trees are so profusely covered with them, as to charm the imagination. Standards of these trees, when viewed at a distance, have been compared to balls of snow; and the nearer we approach, the greater pleasure we receive. These trees may be kept as dwarfs, or trained up to standards; so that there is no garden or plantation to which they will not be suitable."

While all the types of our cultivated fruit cherry-trees grow wild throughout the greater part of Europe, the first large-fruited variety which came into general cultivation is said to have grown in the vicinity of Cerasus, a town of Pontus in Asia, and to have been introduced

thence to Europe. Hence the specific name of the cherry-tree, when it ranked in old systematic botany as a species of plum-tree under the designation of *Prunus cerasus*; and hence also the generic name by which all sorts of cherry-trees are designated in modern botany. The systematically recognised fruit-tree varieties, according to Loudon's Hortus Britannicus, are a shrubby bastard-cherry species, *C. pseudo-cerasus*, introduced in 1821 from China, the wild, the long, and the pale varieties of *C. avium*, and two varieties of *C. semperflorens*, two of *C. Juliana*, four of *C. duracina*, and ten of *C. caproniana*. One of each of the four last-named is normal; and the others are the sessile-flowered of *sempperflorens*, the helmeted of *Juliana*, the heart-bearing, the blunted, and the mammillary of *duracina*, and the Montmorency, the pallescent, the gobbetta, the polygynous, the double-flowered, the peach-flowered, the variegated, the griotte, and the Guigne heart-bearing of *caproniana*. How some or most of these have sprung from the original types, or have mutually hybridized to produce the far more numerous varieties known in nurseries and orchards, no man can distinctly tell. The whole subject of the cultivated cherry-tree, like that of the cultivated apple-tree, befits the attention far more of the professional cultivator than of the scientific botanist.

The May Duke cherry was one of the best known and most esteemed varieties among cultivators in the time of Miller, and it continues to be so among the cultivators of the present day. It was introduced from France about 160 years ago; and is described by M. Merlet, under the highly eulogistic name of *Cerise Royale Hative*; and it is pronounced by Rogers to deserve this name, on account not only of being early, but of deserving to be partaken of by the greatest monarchs that ever swayed a sceptre. It produces fruit for use from the middle of June till August; and, though not quite the earliest of the early varieties, it excels them all in combined richness and abundance. It suits any aspect; but, in order to prolong to the utmost its supply of fruit, trees of it should be planted in every aspect. It serves equally well as a wall-tree and as a standard; and it is the best of all varieties for forcing. When treated as a wall-tree, it should be planted at distances of 20 feet; when treated as a standard, it should be planted at distances, both ways, of 30 feet; and when treated for forcing, it should be grown in a properly constructed cherry-house, and may be made to yield fruit for use during March, April, and May. Several sub-varieties have been brought into cultivation under new names; but all are easily referrible to the original type.—The Early May cherry is sooner ripe than the May Duke; and though decidedly inferior to the latter, one or two trees of it deserve a place in every tolerably large collection.

The Biggareau cherry is one of the best of what are called the heart varieties, and has proved

a valuable hybridizing source of some of the best new kinds. It does not figure in the English catalogues till after the middle of last century; and seems to have been many years in Britain before its character became appreciated. It produces fruit for use from about the middle of July till the latter part of August. Its fruit is large, rather flat at the eye, of a pale yellowish colour, with a fine red toward the sun; its drupe is comparatively small; its pulp is firm, and slightly adheres to the drupe; and its juice is not very abundant in quantity, but has a rich and peculiar flavour, sensibly modified by the flavour of the kernel. Its tree grows best as a full standard, and ranks in that capacity among the second class. When intended for a dwarf standard, it should be grafted about a foot from the ground, and allowed to extend its branches all round; and when grown on wall or espalier, it should be widely trained, so as to prevent its rampant growth and large foliage from over-shading the lower branches. The Biggareau is called by the Dutch the *Graffion*; and, in consequence of having originated in Turkey, it was for some time known in Britain as the Turkey-Heart. Another early, though now disused, name of it was, *Belle Chevereuse*.

Knight's Early Black cherry is a modern hybrid, and was produced, by the well-known phytologist whose name it bears, from a male of the May Duke and a female of the Biggareau. It begins to yield fruit for use about the beginning of July. Its fruit is middle-sized, and somewhat irregularly shaped; it has a nearly black colour when ripened on a south wall, and a less intense colour when ripened on a standard; and its pulp, in all circumstances, is firm and juicy. The tree requires to be planted at the same distances as the May Duke; and when grown on wall or espalier, it needs to be widely trained.—Knight's Elton cherry is another modern hybrid, produced by Knight from the May Duke and the Biggareau. Its fruit ripens about the same time as that of the preceding variety; it is heart-shaped, of good size, and of a marbled red and yellow colour; and its pulp, though not very juicy, is firm, rich, and well-flavoured. Its tree bears better on a wall than as a standard; and, in all ordinary circumstances, is a vigorous grower. When raised as a standard, it requires a sheltered situation; and when raised against a wall, it should be planted at distances of 24 feet, in either an eastern or a western aspect, and trained in pretty open order. The editor of the Pomological Magazine, when giving a list of what he esteems the finest varieties of cherry-trees, expresses high favour for Knight's Elton, and omits all the "heart" varieties, "because the Elton of Mr. Knight is much superior to them all."—Another excellent hybrid from the May Duke and the Biggareau, is the Black Eagle cherry, said to have been raised by a young lady of Mr. Knight's family. It produces fruit for use from the mid-

dle of July till the middle of August.—A fourth excellent hybrid from the May Duke and the Biggareau, also raised by a lady of Mr. Knight's family, is the Waterloo cherry. Its fruit is large, irregularly globular, of a dark brownish red colour, gradually ripening into black; and its pulp is firm, juicy, and well-flavoured. Its tree has much of the habit of the Biggareau, is better suited to the garden than to the orchard, produces fruit for use during the first half of August, and bears best, as to both quantity and quality, when grown against a south-west wall.

The Arch-Duke cherry has been a favourite and well-known variety since some time before the days of Miller; but, in consequence of being a shy bearer when young, and of slowness of habit in ripening its fruit to maturity, it has now become somewhat scarce. Its fruit is paler and larger than that of the May Duke, but of exactly the same shape; and its pulp also is inferior in richness, yet possesses much mellowness and juice. "If permitted to hang upon the tree till quite ripe," says Miller, "it is an excellent cherry; but few persons have patience to let them hang their full time, so rarely have them in perfection." The fruit, in fact, is so late in ripening as to occasion the variety to be often known as emphatically the Late Duke; yet, on account of its very lateness, it makes a grateful figure in the dessert after the fruit of other varieties can no longer be obtained. The tree is plethoric, and a bad bearer in deep, rich soil; and it cannot be properly trained as a dwarf; but it is healthy and prolific in a thin, light soil, and with a northern aspect. A subvariety of the Arch-Duke, slightly altered from the normal form by the influence of soil and situation, is sold under the name of Holman's Duke.—The Royal Kensington Duke cherry is noticed in Merlet's catalogue, and seems to have been introduced to Britain from France by Loudon and Wise. It possesses a medium character between the May Duke and the Arch-Duke; and forms along with them a sort of series, both complete and desirable. Its tree is somewhat hardier than that of the May Duke; and its fruit, though later in ripening than that of the May Duke, is very similar to it in at once size, colour, richness, and flavour.

The Corone cherry is a celebrated old variety, recommended by Miller to a place in every good fruit garden, and at present one of the most popular in the London market. The tree grows to a very large size,—so much so as to afford valuable timber to the cabinet-makers; and it is one of our hardiest and surest bearers, and, at the same time, is tolerably prolific. It exhibits little nicety as to soil or situation, thriving equally well in gravel incumbent upon chalk, and in light loam incumbent upon limestone rock; and it rises truer to its kind from seeds than the tree of any other variety. Its fruit is produced in pairs, and resembles the well-known white-

heart cherry in both shape and size, but is rather more blunt at the point; its colour is dark, purplish black; its pulp is very firm, and less liable than that of most other varieties to be bruised in carriage; and its juice is less abundant than that of the black-heart cherry, but very sweet and pleasant. Three subvarieties of the Corone are cultivated in Hertfordshire and Buckinghamshire, under the names of the Bud, the Small Black, and the Honey; and the fruit of the last of these is very small, pale red, and remarkably sweet, and is largely used for making cherry wine.

Lukeward's cherry was introduced to Britain from Italy, toward the close of the 17th century, by a person of the name of Lukeward. It has long been extensively cultivated in Kent and many other districts; but, in consequence of being less hardy, it has of late been much superseded by the Black-heart. Its tree has a healthy habit, and bears as abundantly as any of the heart varieties. Its fruit closely resembles that of the Corone in both size and colour; but is superior to both it and the black-heart cherry in quality.—The Florence cherry was introduced to Britain from Tuscany, by a person of the name of Houlblon. The tree is erect, middle-sized, and suited better for a wall than for a standard; and it requires a comparatively warm situation. The fruit is large, bluntly heart-shaped, and marbled in colour, somewhat like the carnation cherry; its pulp is firm; and its juice is both abundant and rich.

The Black Circassian or Black Tartarian cherry was introduced under the former of these names in 1794, and under the latter, from a different source, in 1796. The tree requires the same treatment, as to soil, planting, and culture, as the Biggareau; but, in consequence of the fruit being too tender for carriage, it is better suited to the garden than to the orchard. It generally is a good bearer as a standard; and it has also been recommended for forcing. Its fruit is large, irregularly heart-shaped, and of a shining black colour; the pulp is softer than that of the Corone; the juice is both abundant and rich; and the time of ripening is usually about the middle of July, but is sometimes so early as June.—Ansell's Black cherry has not a first-rate character yet may profitably occupy a place in the orchard. The tree is healthy; and the fruit has a fine firm pulp, and is less liable than that of most varieties to receive injury from distant carriage.

The Carnation cherry has long been well known, but has seldom been regarded as of the first class, and is now discarded from all very select lists. The tree, in almost any situation, is a shy bearer; but it has the advantage of being almost equally adapted to any class of treatment or destination, whether for training or as a standard; yet it prefers an east or a west wall when trained, and requires a somewhat sheltered situation when standing apart. Its chief value is

for late bearing; and this property can be prolonged by espalier training. Its fruit is large, and of a handsome globular shape; the colour is a fine marbled red and pale white, and is alluded to in the epithet 'carnation;' the pulp is firm, and not apt to burst in wet weather; and the juice is abundant and agreeably flavoured.

The Kentish or Flemish cherry is one of the most common varieties, and has long been in very extensive cultivation, but begins to be considerably superseded by the Biggareau. It abounds particularly in the orchards of Kent, and in such orchards of many other districts as have a light, dry, sandy soil. The tree suits principally as a standard, and requires, in that character, to be planted at distances of 30 feet; and it generally forms a large, thick, bushy head. Its fruit is liable to crack in wet weather; and, unless when thoroughly ripened in dry weather, is scarcely suitable for the dessert; and it is used principally and very largely by the cook and the confectioner. The name Kentish cherry is used by Miller; and the name Flemish by Langley.

The Morella cherry has, for a very long period, been one of the most useful, profitable, and extensively cultivated varieties. It figured prominently in the time of Miller; and it continues to hold a high place in the select lists of all good judges. But the tree has a peculiar habit, and requires a peculiar management; it possesses a considerable phytological resemblance to the peach; it bears its fruit on the last year's young shoots, so that a full proportion of these must be preserved in pruning; and it develops its fruit in greater or less abundance, and in larger or smaller size, according to the manner and the degree in which the seasonal pruning-knife is applied. It matures its fruit well when trained on a south wall; but is most certain of bearing, and preserves its fruit during the longest possible period, when trained upon a north wall. It excels by far the greater number of wall-trees, in at once the healthiness of its habit, the profusion of its annual shoots, the facility with which it is trained, and the broad and nice control which it affords to the pruner over at once the distribution, the quantity, and the size of its fruit. When the pruner equally distributes its young shoots, the crop is regularly produced; when he cuts away very many of the shoots, the fruit is large; and when he cuts away but a small proportion of the shoots, the fruit is small. In the early training of the tree, lateral shoots may be freely and profusely cut away to obtain a sufficient number of leading branches; but all which are touched by the knife should be lopped off,—not one shortened. The Morella, if planted in a somewhat shady situation, suits well also as a standard. Its fruit is of prime value to the confectioner; and, when perfectly ripened, is by many persons preferred to other kinds of cherry for the dessert.

The White Heart cherry was originally intro-

duced from France; but has, for a very long period, been in extensive cultivation. "This," remarks Mr. Rogers, "is a very old and well known fruit, which, with the black corone and the Kentish, were cried about the streets of London, seventy years ago, and sold for 'a penny a pound.'" Of late years, however, it has been giving place to newer favourites; though it well deserves to have its ancient popularity revived, and is fitted, in almost any situation, to yield a profitable return to the orchardist. The tree is a profuse bearer; but, in consequence of having a spreading and straggling habit of growth, it requires very ample room as a standard. The fruit is heart-shaped, and varies in size according to the nature of the soil on which it is produced; it has a firm pulp and a rich juice; and it possesses the important property of being incapable of cracking in wet weather. Mr. Rogers, in reference to the cry which the editor of the Pomological Magazine and other writers have raised for superseding the heart-cherries by Knight's Elton, suggests that "they have not had sufficient experience of the merits of the Elton to enable them to pass such a sweeping condemnatory sentence against our old tried and established varieties."

The Black Heart cherry is a very fine, old variety, highly in favour in Miller's days, and highly in favour still, but so generally confounded with the Corone as, except among first-class fruiterers, to usurp all the characters of that variety, as well as to wear its own. The tree grows rapidly in its youth, and is comparatively large in its maturity; and therefore ought to be planted in the orchard at not less distances than 30 or even 35 feet,—and on walls and espaliers at not less distances than 24 or 25 feet. It is comparatively ill-suited for dwarf-growth; and may, for training on walls or espaliers, be planted in any aspect except a southern one. Its fruit is heart-shaped, black, and comparatively large; and it is equal in quality to Lukeward's, and superior to the Corone.

The Red Heart, Bleeding Heart, or Gascoigne Cherry, is a powerfully growing tree, well-fitted for the orchard, and requiring a large allowance of room in a wall or an espalier. Mr. Rogers states that a Red Heart cherry-tree, under his care at Surrendon, was planted on a north aspect, and yielded little fruit, and that, on his training the centre branches over, and down the south face of the wall, these soon bore abundantly, and with a very sensible improvement in the quality of the fruit. This variety usually ripens its fruit about the beginning of August. The fruit is heart-shaped, and large, and has, at one end, a small pustular-shaped protuberance; the colour is deep red; the pulp is firm, and slightly adheres to the drupe; and the juice is rich and well-flavoured.

Harrison's Heart cherry was introduced to Britain, about the beginning of last century, by

General Harrison. It presents a considerable resemblance to the Biggareau, and possesses the same adaptations, and requires the same treatment; but it has wider-spreading shoots and more indented leaves,—it produces poorer, larger, and less highly coloured fruit,—and it is much inferior both in prolific habit and in general worth. Yet its fruit possesses the important recommendations of being late in ripening, of strongly resisting the destructive power of wet weather, and of having a very fine appearance in the dessert.

Adam's Crown Heart cherry is near akin to the **White Heart**. Its tree makes a good standard, but is not suited to training; and its fruit ripens about the middle of July, and has delicate pulp, and abundant and agreeable juice.—**Churchill's Heart cherry** makes a hardy and handsome standard, and is well-adapted to the orchard. Its fruit has a bright red to the sun and a pure yellow to the shade; and its pulp is firm, and juice good but scanty.—The **Spanish Heart cherry** is an indifferent or even bad variety, with yellow fruit.—The **Amber Heart cherry** is an old variety, found principally in old orchards, somewhat tender in habit and an indifferent bearer, but prized for the fine amber colour and good-eating properties of its fruit.

The **Purple Griotte** or **Early Purple Guigne** cherry is both the earliest and the best of the early varieties. It was accidentally introduced, in 1822, from Geneva, as one of a collection named **Griotte de Chaux**. It ripens even earlier than the **Early May** cherry, and is superior to it in both the size and the quality of its fruit; and, on these accounts, it has been regarded as a great acquisition to the British garden and orchard. When the **Purple Griotte**, the **Early May**, and the **May Duke** are grown in similar situations, the **Purple Griotte** is in full perfection when the **Early May** is barely ripe, and when the **May Duke** is quite green; and, in general, the **Purple Griotte** may be regarded as a fortnight earlier than the **May Duke**, and as quite equal to it in quality. The fruit of the **Purple Griotte** is compressed, somewhat heart-shaped, and of a good size; its footstalks are long, moderately thick, and well set in an almost round cavity; its colour is a shining dark purple; its pulp is purplish, and tolerably soft and tender; and its juice is abundant, sweet, and richly-flavoured. When this variety is grown upon a south wall, it begins to produce fruit for use in the end of May.

All the varieties of garden and orchard cherry-tree are usually propagated by budding or grafting, upon stocks of the wild black cherry. Stocks of this kind shoot more strongly, and have a sturdier habit and a longer duration than those of any other kind; and therefore are usually preferred. Cherries for sowing may be gathered and sown as soon as ripe; or their drupes may be preserved in sand throughout the winter, and sown in spring. The seed-bed should consist of

light sandy earth. When the seedlings arise, they must be weeded; and if the weather be dry, they ought to be watered. In October of the second autumn after sowing, the young plants should be removed to a nursery-bed of good, fresh, well-worked earth, in an open situation, and planted in rows three feet from row to row, and one foot from plant to plant. In the act of transplanting, the roots should be carefully taken up, and judiciously thinned; and if they indicate a tendency to expend their strength downward, their central stem may be shortened, to induce it to send out lateral growths.

Plants which readily establish themselves in the nursery-bed are usually ready to be budded for dwarfs in the second year after transplanting, but not for standards till the fourth year. Most of the varieties of good cherry-trees require to be budded at nearly six feet from the ground; and hence—unless their graft itself should be trained upward as part of the future stem—they can seldom if ever be budded upon stocks which have stood less than four years in the nursery-bed. Budding is usually performed in summer; and, when it fails, it is repeated in the following spring. When the bud shoots in summer, and is in risk of damage from storms, it may be protected by a soft-binding of bass or any similar material; and in the beginning of March, every successful plant must be headed off about six inches above the bud. Either in the following autumn, or after the lapse of another year, the plants may be removed to their final situation; but, at the time of transplanting, they ought to have their roots judiciously pruned, but must not by any means be headed. The proper distances for both standards and espalier-trees have already been sufficiently indicated.

The best soil for most varieties of cherry-trees is a light, dry, sandy loam, incumbent upon irretentive or well-drained strata. Either great richness of earth, or the presence of more than a very moderate degree of manurial matter, forces the trees into rank growth, gives them a plethoric habit, and impairs or renders positively coarse the quality of their fruit. A frequent top-dressing of soot operates very serviceably by its gradual, regular, and abundant transmutation into carbonic acid gas, or rather by the consequent action of this gas in affording carbonaceous aliment to the trees, and especially in killing all sorts of injurious insects, whether on the ground or on the trees. Fumigation with tobacco smoke, syringing with tobacco water, and washing with strong lime water, are requisite for destroying aphides whenever these exist in such swarms as to make a copious discharge of honeydew. See the articles **APHIS** and **HONEYDEW**. Whenever a tree exudes sap, and forms an exterior gummy secretion, the affected part should be lopped off, and the wound covered with grafting clay.—*Miller's Gardener's Dictionary*.—*Loudon's Hortus Britannicus*.—*Rogers' Fruit Cultivator*.—*The Po-*

mological Magazine.—*Watson's Forester's Manual*.—*The Gardener's Magazine*.—*Marshall on Planting*.—*The Magazine of Domestic Economy*.—*Nicol's Planter's Kalendar*.

CHERRY (WINTER),—botanically *Physalis*. A genus of plants of the nightshade tribe. The common or officinal species, *Physalis Alkekengi*, is a hardy, perennial-rooted herb. It grows naturally in Spain and Italy, but was introduced to Britain about the middle of the 16th century, and has ever since been cultivated in our gardens. Its roots, if unrestrained, creep to a great distance; its stems are numerous, and rise to the height of 12 or 14 inches; its leaves are dark green, and stand on long footstalks, but are very variously shaped, some being angular and obtuse, and others oblong and acute; its flowers are produced on slender footstalks from the wings of the stems, have a white colour, and appear from July till September; and its fruit are round berries about the size of small cherries, soft, pulpy, full of flat kidney-shaped seeds, and enclosed in an inflated husk or bladder. The husk is at first green, but afterwards becomes red, opens, and discloses the cherry-like fruit; and during this latter process, or at the period of autumnal ripening, the plant has a very pretty appearance. The berry has slightly diuretic properties, and has been used in medicine.—Jacquin's species, *Physalis Jacquinii*, is a hardy, yellow-flowered, perennial-rooted, North American herb, of about the same height as the preceding species. It ranks as an esculent.—The Peruvian species, *Physalis Peruviana*, is a greenhouse, evergreen, South American undershrub. Its stem grows 18 inches high; its flowers are white, and bloom from April till October; and its fruit is so far relished as to give the plant the status of a fruit-shrub.—The eatable species, *Physalis edulis*, is an evergreen, tropical, yellow-flowered, two-feet-high herb of South America; and is cultivated, in its native country, as an esculent.—The flexuose species, *Physalis flexuosa*, is an evergreen, Indian, undershrub; and was introduced to Britain about the middle of last century. It grows two feet high, and carries greenish-yellow flowers in July and August. Its root is supposed by the Hindoo physicians to possess cooling, deobstruent, and diuretic properties.—The somniferous species, *P. somnifera*, is an evergreen, two-feet-high, undershrub from Mexico.—The frutescent and the awned species, *P. frutescens* and *P. aristata*, are evergreen, poisonous, yellow-flowered shrubs, of five feet in height, the former from Spain, and the latter from the Canaries.—The arborescent species, *P. arborescens*, is an ornamental, evergreen, yellow-flowered undershrub of the Cape of Good Hope.—Upwards of thirty other species are known to botanists; and about twenty of these have been introduced to Britain; but scarcely any of them challenge attention, and the greater number are weedy, hardy, annuals.—The name of winter cherry is

also popularly given to a curious, twining, tropical annual of the heartseed genus, *Cardiospermum Halicacabum*. Its leaves are broad, lanceolated, and subdivided, and are used on the Malabar coast for pulmonic complaints; and its root is mucilaginous and somewhat nauseous, and is used, in many parts of India, as an aperient and an antibilious medicine.

CHERVIL, — botanically *Chærophyllum*. A genus of herbaceous plants, of the umbelliferous family. The cultivated species, *Chærophyllum sativum*—called by Linnæus *Scandix cerefolium*, and by some of the most recent remodellers of systematic botany *Anthriscus sativa*—is a hardy, native annual of Great Britain. It grows wild on banks, hedges, and waste grounds; and has long been cultivated in gardens, as an aromatic, pot, and salad herb. Its stem rises to the height of about 20 inches; its flowers are white and bitter; and its seeds are smooth, furrowed, and comparatively large. It soon runs to seed, and, when wanted for more than a week or two, requires to be sown in long-succession. It may be sown from April till September, for summer and autumn use; and, in the latter part of autumn, to stand through the winter. The only full or even sure crops of it are those sown in autumn, from newly ripened seed. It is not fastidious as to soil, and may be raised in drills of from 6 to 9 inches asunder. It was much used for culinary purposes by the ancients, and continues to be extensively used in salads by the French and in soups by the Dutch; but it is now comparatively little used in Britain. Some poisonous umbelliferous plants are very apt to be mistaken for it; so that no chervil should be used but such as is specially cultivated.

The wood or wild species, *Chærophyllum sylvestre*—now sometimes called *Anthriscus sylvestris*, and popularly smooth cow parsley—is a perennial-rooted herbaceous weed of British hedges, orchards, and pastures. Its root is fusiform and somewhat milky; its stem is striated, and about 3 feet high; and its flowers are snowy white, and bloom in May and June, and are a fine natural ornament of our hedges and the margins of our fields. The whole plant has an agreeable flavour, somewhat like that of carrots, and is eaten by rabbits, asses, cows, and other animals, and serves both to please the human eye with its beauty, and to prove to the farmer the fertility of the soil on which it grows; yet, economically viewed, it is altogether a weed, and ought to be exterminated from every pasture-field in spring.—The giddy species, *Chærophyllum temulum*, is a biennial, white-flowered, three-feet-high weed of the same situations as the preceding species.—Four hardy, perennial-rooted, herbaceous species, the fine-leaved from the south of Europe, the aromatic from Germany, and the Canadian and Clayton's from North America, are sometimes grown in our gardens as ornamental plants. Upwards of 20 other species are known to botan-

ists, and most of these have been introduced to Britain; but all are devoid of interest.—A biennial species of the carrot genus, *Daucus gingidium*, is also popularly called chervil.

CHERVIL (ROUGH). See ANTHRISCUS.

CHESNUT. See CHESTNUT-TREE.

CHESSEL. See CHEESE-VAT.

CHEST. The large bony cavity of the upper part of an animal's body, formed by the back-bone, the ribs, and the breast-bone, and containing the heart, the lungs, and some other organs.—A chest is also any kind of box for household or permanent use.

CHEST-FOUNDER. A disease in the pectoral muscles of horses. It indicates itself by such stiffness in moving as cannot be referable to the feet; it consists in inflammatory action, swelling, sensitiveness to the touch, and sometimes considerable fever; it seems to be occasioned by exposure to cold, riding against a very cold wind, too much confinement to the stable, or the improper treatment of inflammation between the ribs; and it is closely akin, both in its pathology and in its method of cure, to the chest-disease called anticor. See the article ANTICOR. The proper internal remedies are attenuants, soft pectorals, gentle purges, and bleeding; and the best external appliances are rowelling, warm embrocations, warm clothing, and comfortable stabling.

CHESTNUT. See CHESTNUT-TREE.

CHESTNUT (HORSE). See ÆSCULUS.

CHESTNUT-HORSE. A horse principally or wholly of a chestnut colour. This colour in horses is usually reckoned an original or simple one; yet it comprises several varieties of tint, from light to dark,—each prevailing tint frequently comprises two or more shades,—and some of the tints are sometimes extensively superseded by markings of white. In a tint of several shades, the individual hairs, rather than spots or parts, exhibit the existing diversity; and in tints intermediate between bright and very dark, the hairs appear as if gilded toward their points, and in consequence produce an aggregate effect of the nature of lustrous brilliance. In many coarse-bred, light-coloured chestnut horses, the whole face is white; and in a large proportion of all kinds of light chestnut horses, the legs, feet, tail, and mane are much marked with white. Whiteness in the feet in any chestnuts is reckoned a deformity; and whiteness in the tail or in the mane is reckoned an eminent beauty. Dark-coloured chestnut horses are often quite uniform in colour, and, as a class, are much more free from markings than the light-coloured. Dark chestnuts have, in many instances, a fiery temperament, and in general are more subject to contraction in the feet than any other kind of horses; and light chestnuts, in a considerable proportion of instances, have less than an average strength of constitution.

CHESTNUT-TREE,—botanically *Castanea*. A

genus of fruit, ornamental, and timber trees, of the amentaceous tribe. The common species, sweet chestnut or Spanish chestnut, *Castanea vesca*—formerly called *Fagus castanea*—grows wild in the woods of England, and of several other countries of Europe. The fact of its being indigenous in England has frequently been questioned; but seems to be placed beyond all reasonable doubt by the comparatively abundant occurrence of it in the roofing of very old houses. Had not the chestnut-tree grown wild and plentifully in England ten or twelve centuries ago, its timber must have been imported in such profusion as could not have failed to be noticed in history, and at so extravagant a price as must have proved its importers to be both surpassingly foolish and lavishly rich. In open situations, it throws out large spreading arms, and forms a magnificently strong-featured outline; and in close or somewhat crowded situations, it soars aloft with a stem as clean and straight as an arrow, to a great height. "The Spanish chestnut," remarks Sir Thomas Dick Lauder, "is perhaps the noblest tree in our Spanish sylvia. In all countries, as well as in this, it has exceeded the oak both in height and magnitude; and certainly it is not a whit behind that recognised 'monarch of our woods.'" If not the noblest of our forest trees, it at least belongs to the first rank; and when planted on suitable soil in a proper situation, and with a due attention to grouping and exterior effect, it is a most picturesque object, and contributes a powerful element to the beauties of the park, or the achievements of landscape-gardening. Its mean height, in quite ordinary circumstances, is not less than about 50 feet. Its leaves are long, rather large, strongly marked with nerves, and of a dark and somewhat glossy appearance in summer, but change to a yellow hue in autumn. Its male flower has a naked amentum, a naked calyx, and a five-petalled corolla, and appears in May and June; and its female flower has a mucicate, five or six leaved calyx, and no corolla. Its seeds or nuts are ovate, and three-sided; and every three of them are enclosed in a roundish capsule, covered with soft spines.

A numerous and good specimen of the Spanish chestnut as grown in Britain, occurs in a somewhat long avenue at Aberuchill Castle, in Strathearn, in Perthshire. Trees of it flank both sides of this avenue; and all are of large size and fine appearance, averaging from 10 to 12 feet in girth, and from 50 to 60 feet in height. Remarkably fine specimens occur on the banks of the Tamer in Cornwall, on the estate of Buckland, and in several places in Kent. The largest and oldest Spanish chestnut known in Britain is one in Lord Ducie's park at Totworth, in Gloucestershire: this tree is said by Bradley to have been styled, in 1150, the great chestnut of Totworth, and by the historian of Gloucestershire to have been traditionally reported as older than the reign of King

John; and it is reported by Bradley to have had in his day a girth of 51 feet at two yards from the ground, and by Sir Robert Atkins to have had a girth of 57 feet. Mr. Marshall, however, both denies the accuracy of these measurements of it, and asserts it to be, not one tree, but two trees. Brydone, during his tour through Sicily, measured the remnants of a celebrated chestnut-tree, standing at the foot of Mount *Ætna*, and called *Castagne de Cento Cavilla*, and found them to have a girth of 204 feet!

Coppices of common chestnut are of comparatively great value, affording an excellent produce every ten or twelve years for hop-poles, hoops, and all kinds of elastic props and handles. Chestnut underwood in a favourable climate and on good soil, rarely fails to yield fair profit; and lines and belts of young chestnuts for shelter combine their immediate advantage with a large amount of final utility. The wood of young chestnuts serves better for gate-posts or for any other purpose which involves constant contact with the ground, than any other kind of wood except yew and larch. Older chestnut timber is preferable to elm as a substitute for oak, and has sometimes been lauded as a good succedaneum for the coarser kinds of mahogany in the making of furniture. For some uses, particularly for door-jambs, window-frames, and several other objects of house-carpentry, it is nearly equal to oak; but for beams, rafters, and other objects destined to bear great loads of variable weight, it has a certain deceitful brittleness which renders it quite unfit, and occasionally not a little dangerous. Cask staves of chestnut possess the double recommendation of not being liable to shrink, and of not imparting a foreign colour to liquors which the casks may contain.

The nuts of the Spanish chestnut-tree, as grown in Britain, seldom attain any tolerable degree of perfection. Some nurserymen have introduced early and prime varieties from the south of Europe, and have subjected them to the most powerful and approved methods of cultivation, in the sanguine but rather forlorn hope of converting them into valuable fruit-trees. The principal esculent use of British nuts is the same inglorious yet important one as that of acorns,—the feeding of swine. Foreign nuts, however, possess much economical value as an article of human food; and, in some instances, they are dried, preserved for a comparatively long period, and baked into bread. “In the Cevennes,” says Mr. Cadell, “the inhabitants have a process of kiln-drying them, so that they will keep good for two or three years. The process consists in exposing the chestnuts, on the floor of a kiln, to the smoke of a smothered wood fire. The heat is applied gently, so as to make the internal moisture transpire through the husk of the chestnut. The fire is kept gentle for two or three days, and then is gradually increased during nine or ten days. The chestnuts are then

turned with a shovel, and the fire is continued till they are ready. This is known by taking out a few and thrashing them; if they quit their inner skin, they are done. The chestnuts are then put in a bag, and thrashed with sticks, to separate the external and internal husk. If the husks are left on, as is practised in the Limousin, the chestnuts become black, by imbibing from the husk the empyreumatic oil of the wood smoke, and do not keep so well.”

The chestnut-tree thrives in sandy or gravelly soils, in any sheltered or mild situation; it prospers still more, and often attains its noblest condition, in rich sandy loam; and it usually does best of all in very rich loam, or in friable clay, upon thoroughly porous substrata. The small nuts of English growth serve quite as well for raising either timber or ornamental trees, as seeds procured from abroad. But when foreign seeds are preferred, they ought to be preserved in sand, and put to the test in water. The nuts should be put in the ground in February, at four inches distance from one another, with their eye uppermost, in drills four inches deep, and twelve inches asunder. The seedlings must be kept thoroughly weeded; they may remain two years in the seed-bed; they may be transplanted in February, but will do better to be transplanted in October; they should, at transplantation, have their tap-root shortened, and be placed in rows at a foot from plant to plant, and a yard from row to row; and they may remain in the nursery-bed, the stronger during three years, and the weaker during four. Seedlings are liable to have crooked stems; but when they are transplanted into their final situation, and have ample room and abundant air, they become straight.

Any one sowing of chestnuts, even though all the nuts sown were from one tree, will produce some plants with fruit or leaves observably different from those of the normal chestnut tree. Most of such varieties are slight and fugitive; but some, produced in former times, are so well defined as to look almost like distinct species, and, for the sake of either ornamental features or the properties of their fruit, are preserved and propagated by inarching and grafting. In many countries in which the trees are cultivated for their fruit, scions of plants bearing the largest and fairest fruit are grafted upon stocks raised from nuts; but most of such plants are defective in ornamental character, and all are very poor or totally useless as timber trees. In our own country, six well defined varieties are commonly raised in the public nurseries as ornamental trees;—the fern-leaved or asplenium-leaved, *C. asplenifolia*, *heterophylla*, *salicifolia*, or *laciniata*; the American, *C. Americana*; the smooth-leaved or shining-leaved, *C. glabra* or *C. foliis lucidis*; the spiral, *C. cochleata*; the glaucous-leaved, *C. glauca*; and the variegated-leaved or gold-striped, *C. variegata* or *C. foliis aureis*. All these varie-

ties, particularly the fern-leaved, the shining-leaved, and the variegated-leaved, are highly ornamental. The American differs little from the English; and ranks much higher for utility than for ornament. It flourishes on gravelly soils on the sides of mountains, in Georgia, in the Carolinas, and in other parts of North America, up to the 44th parallel of northern latitude. Its nuts are smaller and sweeter than those of the Spanish chestnut of Europe; and are sold, in great plenty, in the markets of Baltimore, Philadelphia, and New York. The timber also is equal in quality to that of the European tree.

The dwarf or chinquapin chestnut, *Castanea pumila*, is a native of North America, and was introduced to Britain at the close of the 17th century. It is a mere shrub of from 9 to 14 feet in height; and is remarkable for the beauty of its foliage and the smallness of its fruit. Its stem is covered with a brown-coloured bark, and divides into several branches near the top; its leaves are oval-spear-shaped and acutely serrated, and are somewhat hoary below; its flowers have a greenish-yellow colour, and grow in the form of slender knotted catkins; and its nuts are small, but seldom ripen in England. This species is propagated from foreign seeds, and thrives best in a moist soil and shady situation.—The Chinese species, *Castanea chinensis*, is a deciduous timber-tree of about the same height as the common Spanish species.—The Indian species, *Castanea Indica*, was introduced to Britain from India in 1827, and is a tender evergreen tree, of about 40 feet in height.—*Memoirs of the Caledonian Horticultural Society*.—*Loudon's Works*.—*Strutt's Sylva Britannica*.—*Gilpin's Forest Scenery*.—*Rogers' Fruit Cultivator*.—*Watson's Forester's Manual*.—*Hunter's Georgical Essays*.—*Marshall on Planting*.—*Miller's Dictionary*.—*Knowledge Society's Ornamental Planting*.

CHEVIOT SHEEP. See SHEEP.

CHEWING-BALL. An antiquated medicinal appliance for restoring the appetite of an infirm or sickly horse. It was a compound of tonic and aromatic substances wrapped in a piece of linen cloth, and fastened to the horse's mouth or to the bit of his bridle, that he might prolongedly chew it in the stable or upon the road.

CHEWING THE CUD. See RUMINATION.

CHICKASAW PLUM. See CHERRY.

CHICKENS. See POULTRY.

CHICKLING-VETCH,—botanically *Lathyrus Sativus*. A hardy, annual, climbing, herbaceous, leguminous, agricultural plant, of the sweet-pea genus. It is a native of the south of Europe, and was introduced to Britain in 1640. It has been the topic of great diversity and violent collision of opinion; and is regarded by some persons as a noxious and even poisonous weed, and by others as a valuable, nutritious, agricultural plant. Duvernoy denounced it as causing rigidity of the limbs, delirium, and other appalling effects, and George, Duke of Wurtemberg, in 1671, as well

as several of his successors, forbade it to be cultivated. But the farmers of some parts of the continent, and particularly those of some of the provinces of France, still extensively raise it, not only as green fodder for horses and cattle, but also for using its seeds in their own soups, and for grinding them in mixture with grain to be given as food to hogs and poultry, and baked into bread for man. The plant climbs and seeks support in the manner of garden pease and sweet pease; its stem usually attains a height of between 3 and 4 feet; its leaves are small and gramineous; its flowers are numerous, solitary, about half the size of those of the garden pea, and either blue, white, or intermediate colour according to the variety; its pods are about an inch and a half in length, and three-quarters of an inch in breadth, flattened, and furnished with two wing-like appendages along the back; and its seeds are irregularly shaped, flattened, brownish in colour, and somewhat agreeable in taste.—The everlasting pea, *Lathyrus latifolius*, and some other species of *Lathyrus*, have sometimes been called chickling-vetches.

CHICK-PEA,—botanically *Cicer*. A hardy, annual, herbaceous, agricultural plant, of the vetch division of the leguminous family. It constitutes a genus of itself, and takes for its specific name, popularly ram's head, and botanically *arietinum*. It grows wild in the south of Europe, the north of Africa, and the west of Asia, and was introduced to Britain about the middle of the 16th century. Several stems grow from each seed, and are hairy, and about 18 inches high; its leaves are long, pinnate, and greyish; its leaflets are small, roundish, and serrated, and amount, in each leaf, to 7, 8, or 9 pairs and a terminating odd one; its flowers are small, and stand on long footstalks, and are white, red, or purple, according to the variety; its pods are short, hairy, and two-seeded; and its seeds are about the size of common pease, but have a little protuberance on one side. This plant is much cultivated in Spain, and is held in high esteem as a leguminous esculent; but it is too tender for field cultivation in England.

CHICKWEED. A numerous and diversified group of low herbaceous plants, partly economical, but chiefly weedy. Chickweed is one of the most loosely and extensively applied of all the names of popular botany; and, though generally understood to refer *par excellence* to the abundant and constantly-flowering annual weed, *Stellaria media*, it is currently used to designate so many species and even genera as to be almost meaningless and bewildering. Most of the species of *stellaria* are indifferently called chickweed and stitchwort; all the species of *alsine* are commonly called chickweed; the *cucubalus* plant and some of the species of *silene* are sometimes called chickweed; all the species of *cerastium* are usually called mouse-ear chickweed; the two species of *trientalis* are sometimes called winter-green chick-

weed; several species of veronica are sometimes called speedwell chickweed; two species of arenaria are called respectively sea chickweed and plantain-leaved chickweed; the umbellated species of holosteum is called umbelliferous chickweed; and both of the species of montia are usually called water chickweed. See the articles STITCHWORT, ALSINE, CAMPION, CATCHFLY, MOUSE-EAR CHICKWEED, WINTER-GREEN, SPEEDWELL, SANDWORT, HOLOSTEUM, and MONTIA.

CHICORY. See SUCCORY.

CHILOCHLOA. A genus of hardy grasses, of the canary-grass tribe. The name means 'fodder-grass,' but is not appropriate. Böhmer's species, *C. Böhmeri*, formerly called *Phleum Böhmeri*, is an annual weed of the plains of England, grows about 20 inches high, and flowers from July till September. The rough species, *C. aspera*, formerly called *Phleum paniculatum*, is an annual weed of the heathy grounds of England, and grows to the height of 12 or 14 inches. The sand species, *C. arenaria*, formerly called *Phalaris arenaria*, is an annual weed of the sea-coasts of England, and grows to the height of 6 or 8 inches. Two species, the one perennial, the other annual, but neither of any moment, have been introduced from Austria and the Caucasian mountains.

CHIMNEY. How far the Greek and Roman architects were acquainted with the construction of chimneys, is a matter of dispute. No traces of such works have been discovered in the houses of Pompeii, and Vitruvius gives no rules for erecting them. The first certain notice of chimneys, as we now build them, is believed to be that contained in an inscription at Venice over the principal gate of the Scuola Grande di Sta. Maria della Carita, which states that, in 1347, a great many chimneys were thrown down by an earthquake. Chimneys require much attention, to make them secure and prevent their smoking, so great an annoyance to domestic comfort. It seems, at present, to be acknowledged, that it is much better to exclude the cold damp air from the flues, by narrowing the aperture at the top, than to give a larger vent to the smoke, at the risk of admitting a quantity of air to rush down the flue. For this reason, chimney-pots are of great use. In Prussia, where the architectural police is strict, great attention is paid to the erection of chimneys, and to the regular sweeping of them, the chimney-sweepers being bound to sweep the chimneys of a certain number of streets within a regular time; and, though the interference of a police in subjects of domestic economy is a delicate matter, the numerous fires which take place from the careless construction of chimneys, seem to make some public supervision of their security desirable. The longer a chimney is, the more perfect is its draught, because the tendency of the smoke to draw upwards is in proportion to the different weight of the column of air included in a chimney and an equal column of external air. Short chimneys

are liable to smoke, and fire-places in upper stories are, therefore, more apt to smoke than those in the lower ones. Two flues in the same chimney should not communicate with each other short of the top. Some chimneys, in large establishments, are very remarkable for their size.

CHIMONANTHUS. A genus of ornamental shrubs, of the Calycanthus tribe. The fragrant species, *Chimonanthus fragrans*—formerly called *Calycanthus præcox*—is a native of China and Japan, and was introduced to Britain in 1766. It is a deciduous shrub, of about 8 or 10 feet in height, and blooms from December till February. It is usually esteemed tender; but it has been found, on fair trial, to be at least as hardy as the peach-tree. It is one of the most fragrant and delightful of plants; and is trebly welcome in consequence of diffusing its odours during the coldest and gloomiest season of the year. It richly deserves a place on any wall of sufficient warmth for the peach-tree, or in the conservatory or the greenhouse. A very elegant bouquet for the breakfast table in winter consists of a few flowers of chimonanthus, one or two camellias, and a few sprigs of myrtle.—Three varieties of it are in cultivation, *C. f. grandiflorus*, *C. f. luteus*, and *C. f. parviflorus*,—the first tall in the plant as well as large in the flower, and the second and third of comparatively recent introduction. Two other species are known to botanists. The name *Chimonanthus* signifies "winter-flower."

CHIMOPHILA. A genus of hardy, evergreen, medicinal herbs, of the heath tribe. The corymbose-flowered species, *Chimophila corymbosa*, formerly called *Pyrola umbellata*, is a native of Siberia, northern Europe, and most parts of North America, and was introduced to Britain about the middle of last century. It possesses considerable relationship, both botanical and medicinal, to the bear's grape or creeping arbutus, *Arctostaphylos Uva Ursi*. Its root is woody and creeping; its stems are ascending, and grow to the height of 6 or 8 inches; its leaves are evergreen and coriaceous; and its flowers stand on small footstalks, and have a cream colour edged with purple, and appear in June. This plant has a pungently aromatic taste, and has diuretic, tonic, astringent, antiseptic, and antifebrile properties. It has long been in reputation among the American Indians as a remedy for fever and rheumatism; it was successfully used, during the revolutionary war of America, in cases of typhus fever; it has been used with good effect, by some of our own most distinguished physicians, in cases of dropsy; and it was recently admitted to a recognised and established place among our materia medica. "*Pyrola umbellata*," says Dr. Thomson, "is diuretic and tonic. It has been given successfully in ascites, after digitalis and other diuretics had failed; and has also proved serviceable in acute rheumatism, intermittents, and other diseases assuming an intermittent type. It produces an agreeable sensation in the sto-

mach soon after it is swallowed, increases the appetite, and acts powerfully on the kidneys." The whole plant, including roots, stems, and leaves, dried, cut small, and decocted, is used. The spotted-leaved species, *Chimophila maculata*, grows to the same height, has the same medicinal properties, and was introduced to Britain about the same period as the corymbose-flowered species; but it is readily distinguished by the whiteness of its flowers.

CHINA-ASTER,—botanically *Callistemma*. A genus of hardy, elegant, annual flowering-plants, of the composite family. The garden species, *Callistemma hortense*, formerly called *Aster chinensis*, is a native of China, and was introduced thence to Britain in 1731. It usually has a height of about 20 inches, and blooms from July till the time of wintry frost. It ranks as a florist's plant, and is everywhere cultivated as one of the conspicuous beauties of the flower-garden. Its flowers are, in a large proportion of instances, more or less double; and they possess a very large disc, and appear like greatly magnified double daisies. Six well established varieties are recognised in systematic botany,—the normal plant, the red, the white, the variegated, the short-flowered, and the double; and while all are more or less variegated, the three last are eminently so, and the three first have as their prevailing colour respectively blue, red, and white. Seeds may be sown either on a hotbed very early in spring, or on a warm border in the latter part of April; and the young plants, as soon as they have acquired five or six leaves, should be pricked out into beds or border-rows, and placed at distances from one another of about six inches. Two great defects characterize the China-aster, and occasion it to be totally disesteemed by fastidious florists,—the coarseness of its conformation, or want of delicacy in its texture, and the staring, hungry, vacant appearance of its single flowers.—The Indian species, *Callistemma indica*, formerly called *Aster indicus*, was introduced to Britain in 1820. It attains only two-thirds the height of the Chinese species, but competes with it in beauty, and resembles its normal plant in the colour of the flowers. The name *callistemma* signifies "the handsomest crown," and alludes to the elegance of the large, expanded circular corolla.

CHINA-ROSE. See **ROSE**.

CHINE. The spine of a horse, or ridge of a horse's back; also the part of a hog's carcase, containing the spine.

CHINEFELLON. Acute rheumatism in the loins of an ox, attended or followed by low fever.

CHINESE-TREE. See **PEONY**.

CHINKED-CHINE. See **ANCHYLOSIS**.

CHINQUAPIN. See **CHESTNUT-TREE**.

CHIOCOCCA. See **SNOWBERRY**.

CHIONANTHUS. See **FRINGE-TREE**.

CHIPPING. A virulent disease of the stomach and bowels of chickens. It usually occurs when

the birds are three or four weeks old, and seems to be occasioned by indigestion, or by exposure to cold and wet. A chicken affected with it ensconces in a corner, contracts itself into a lumpish posture, expands or lifts erect all its feathers, utters a short and lugubrious chirp, refuses to eat, rapidly loses flesh, and, if unattended to, very speedily dies. The disease, in its earlier stages, is curable; but, when fully established, is always fatal. Chickens affected with it should be kept warm, gently purged, and fed with good thick gruel while ill, and with split grits when convalescent.

CHIRITA. A genus of ornamental plants, of the gesneria tribe. The Chinese species, *C. sinensis*, was recently introduced from China by the London Horticultural Society. It is a dwarf, herbaceous, greenhouse plant, with very much of both the appearance and the habit of a gloxinia. Its leaves are large, oblong, almost oval, and hairy, and sit close to the soil; and its flowers rise in twos or threes, on short stems just above the foliage, are shaped nearly like the flowers of gloxinia or foxglove, and have a beautiful soft lilac colour, with a white throat. The plant is very easily cultivated in the cool part of a stove.

CHIRONIA. A genus of ornamental, evergreen, Cape-of-Good-Hope undershrubs, of the gentian tribe. About a dozen species have been introduced to Britain; and a few others are known to botanists. The height of the introduced species varies from 1 foot to 3½ feet; and the colour of the flowers of two is yellow, of one white, and of the others red or purple. The root of one of the best known is fibrous, and spreading; the stems are round, slightly ligneous, and of very soft texture; the branches proceed from all sides, and grow erect; the leaves are succulent, and an inch or more long, and the eighth part of an inch broad; and the flowers are produced at the ends of the branches, and have a tubulous form, but expand at the top like the flowers of periwinkle.

CHIVES, or **CIVES**,—botanically *Allium schænoprasum*. A small, hardy, esculent, bulbous-rooted perennial plant, of the onion genus. It grows in close tufty bunches, to the height of 6 or 7 inches, and carries inconspicuous flesh-coloured flowers in May and June. It is found wild in the meadows and pastures of England; and is allowed a place, sometimes an unduly prominent one, in kitchen and cottage gardens. Its leaves and bulbous roots, but particularly the former, are used in salads, soups, and for the various other purposes to which either young or full-grown onions are applied; and they are much esteemed on account at once of the delicacy of their flavour, the easiness of their cultivation, and the earliness and length of time of their being in season. Chives are propagated by simple division of the tufts in which they grow; and they afterwards need no other culture than to be kept free from weeds. They may be propagated at any time between the end of January and the

early part of June, but succeed best when propagated in March; and they may be re-propagated throughout a corresponding range of time in autumn. In propagating and transplanting, eight or nine plants or bulbs may be put into each dibble-hole, and the dibble-holes may be about nine inches asunder; and in gathering the plants for use, the leaves, as long as they continue green, may, time after time, be shorn away near the surface of the ground, or the roots may, after the decay of the leaves, be taken up and placed in a store-room.

CHIZZLE. Bran, or the husky portion of ground wheat.

CHLORA. See **YELLOW-WORT.**

CHLORANTHUS. A small genus of ever-green, tropical plants, constituting the natural order *Chloranthæ* or *Chloranthaceæ*. They are allied to the peppers, and are distinguished from the orders nearest them by their jointed-stems and their opposite leaves and intermediate stipules. Four species are known to botanists; and three of these have been introduced to Britain. The officinal species, *Chloranthus officinalis*, is a very powerful stimulant; but neither this species nor any other possesses any horticultural interest.

CHLORINE. The discovery of this gas was made in 1770, by Scheele, and named, by its discoverer, *dephlogisticated marine acid*. The term *dephlogisticated* had exactly the same import as that of *oxygenated*, soon afterwards introduced by Lavoisier. From its peculiar yellowish-green colour, the appellation of *chlorine* has been given to it.

Chlorine gas is obtained by the action of muriatic acid on the peroxide of manganese. The most convenient method of preparing it is by mixing concentrated muriatic acid, contained in a glass flask, with half its weight of finely-powdered peroxide of manganese. On the application of a moderate heat, the gas is evolved, and should be collected in inverted glass bottles, filled with warm water. In order to comprehend the theory of this process, it must be premised that muriatic acid consists of chloride of hydrogen. The peroxide of manganese is composed of manganese and oxygen. When these compounds react on one another, the peroxide of manganese gives up a portion of its oxygen to the hydrogen of the muriatic acid, in consequence of which water is generated, and chlorine (the other ingredient in muriatic acid) is liberated. The method which is employed in the arts, and which is the most economical, is the following:—Three parts of common salt (muriate of soda) are intimately mingled with one of the peroxide of manganese, and to this mixture two parts of sulphuric acid, diluted with an equal weight of water, are then added. By the action of sulphuric acid on the muriate of soda, muriatic acid is disengaged, which reacts, as before explained, upon the peroxide of manganese; so that, instead of adding

muriatic acid directly to the manganese, the materials for forming it are employed.

Chlorine is gaseous under a common atmospheric pressure. It is twice and a half heavier than atmospheric air, or its specific gravity is 2.5. The gas has a yellowish-green colour. Of all the gases, it is the most insupportable in its action on the lungs. When pure, it occasions immediate death if an animal is immersed in it; and even when largely diluted with common air, it cannot be respired with safety. It occasions a severe sense of stricture at the breast, which renders it impossible to make a full inspiration. This continues for a considerable time after it has been inspired, and has often produced a permanently injurious effect. When thoroughly dried, by exposure to fused chloride of calcium, it suffers no change, though cooled to 40°. When prepared over water, however, so as to contain a quantity of aqueous vapour, it condenses on the sides of the vessel even at a temperature of 40°; and, if surrounded by snow or ice, it shoots into acicular crystals of a bright-yellow colour, and sometimes two inches in length, which remain attached to the sides of the vessel. This solid is a hydrate of chlorine, and, when heated to 50°, it melts into a yellowish oily fluid. Chlorine is absorbed by water, in a quantity which increases as the temperature diminishes. At 50°, the water takes up about twice its volume. The solution has a yellowish-green colour, and its odour is that of the gas itself. Its taste is rather styp-tic than sour, and the liquid, like the gas, has the property of destroying the vegetable colour. Hence it may be employed in bleaching. It is not changed by a boiling temperature. Solution of chlorine is decomposed, however, by exposure to the solar light; the chlorine attracts hydrogen from the water, forming muriatic acid, which remains dissolved, and pure oxygen is disengaged. Chlorine gas supports the combustion of a number of inflammable substances. A lighted taper burns in it, though feebly, with a red flame; phosphorus takes fire when immersed in it; and a number of the metals, as antimony, arsenic, copper, and others, if introduced into it in leaves or filings, burn spontaneously. Potassium and sodium burn vividly in it. In these cases, the inflammable or metallic substances are believed simply to unite with the chlorine. Chlorine combines with many of these bases in more than one proportion. When in one proportion, the compound is called a *chloride*; when in two, a *bi-chloride*, or a *deuto-chloride*, &c. Whenever a metallic chloride, which is soluble in water, is thrown into that fluid, it is conceived to be instantly converted into a muriate; the water present is decomposed, its oxygen goes to the metallic base, and its hydrogen to the chlorine, and a muriate of an alkali, earth, or metallic oxide, is formed. Thus common salt, when dry, is a chloride of sodium: it is no salt, containing neither acid nor alkali, but, whenever it is dis-

solved in water, it is immediately transformed into a salt; the sodium attracts oxygen and becomes soda, and the chlorine takes hydrogen and becomes muriatic acid, and muriate of soda exists in the solution. When any of the compounds of chlorine, with inflammable substances or metals, are subjected to the action of a galvanic apparatus sufficiently powerful to decompose them, the chlorine is always evolved at the positive pole of the battery, and the base at the negative pole. In this respect, and in its power of supporting combustion, chlorine is analogous to oxygen.

One of the most important chemical properties of chlorine is displayed in its action on the vegetable colours. Many of them it entirely destroys; and even those which are the most deep and permanent, such as the colour of indigo, it renders faint, and changes to a light yellow or brown. This agency is exerted by it, both in its gaseous and its liquid form. The presence of water is, however, necessary to this. Hence, when the gas destroys colour, it must, probably, be enabled so to do by the hygrometric water it contains. It is accordingly found, that, when freed from this, it does not destroy the colour of dry litmus paper. The destruction of colour appears to be owing to the communication of the oxygen of the water present to the colouring matter: the chlorine attracts the hydrogen of the water to form muriatic acid, and the evolved oxygen unites with the colouring matter, and, by changing its constitution, alters its relation to light, so that the tint disappears. Berthollet applied this agency of chlorine to the process of bleaching, and with such success as to have entirely changed the manipulations of that art. The method of using it has been successively improved. It consisted, at first, in subjecting the thread or cloth to the action of the gas itself; but the effect, in this way, was unequally produced, and the strength and texture were sometimes injured. It was then applied, condensed by water, and in a certain state of dilution. The thread, or cloth, was prepared as in the old method of bleaching, by boiling first in water, and then in alkaline lye; it was then immersed in the diluted chlorine: this alternate application of alkali and chlorine was continued until the colour was discharged. The offensive, suffocating odour of the gas rendered this mode of using it, however, scarcely practicable: the odour was found to be removed by condensing the chlorine by a weak solution of potash: lime, diffused in water, being more economical, was afterwards substituted. Under all these forms, the chlorine, by decomposing water, and causing oxygen to be imparted to the colouring matter, weakens or discharges the colour, and the colouring matter appears to be rendered more soluble in the alkaline solution, alternately applied, and of course more easily extracted by its action. More lately, a compound of chlorine and lime has been em-

ployed, prepared by exposing slacked lime to chlorine gas: the gas is quickly absorbed, and the *chloride of lime*, as it is called, being dissolved in water, forms the bleaching liquor now commonly employed, and which possesses many advantages. In using it, the coloured cloth is first steeped in warm water to clean it, and is then repeatedly washed with a solution of caustic potash, so diluted that it cannot injure the texture of the cloth, and which is thrown upon it by a pump; the cloth is then washed and steeped in a very weak solution of chloride of lime, again washed, acted on by a boiling lye as before, and again steeped in the solution; and these operations are performed alternately several times. The cloth is lastly immersed in very dilute sulphuric acid, which gives it a pure white colour; after which it is washed and dried. Chloride of magnesia has been substituted, with great advantage, for that of lime, in whitening cloth for calico printing; the cloth, when lime is used, retaining a little of it, which, in the subsequent operation of clearing by immersion in weak sulphuric acid, forms sulphate of lime, which remains, and affects the colours when it is dyed; while the sulphate of magnesia is so soluble, that it is entirely removed. Chloride of alumine has been employed to discharge the colour of the Turkey-red dye, which resists the action of other chlorides, and is only discharged by chlorine gas, by an operation very injurious to the workmen.

Another important application of chlorine gas is that of destroying or neutralizing contagion. Acid vapours, sulphurous acid in particular, under the form of the fumes of burning sulphur, had often been employed for that purpose; but chlorine, from the facility with which it decomposes the different compound gases that contain the elements of vegetable and animal matter, and which may be supposed to constitute noxious effluvia, is superior to any other agent, and is now universally employed for the purposes of fumigation. It is the only agent which can administer relief in cases of asphyxia from sulphureted hydrogen; and it has been found useful, among such persons as are obliged to frequent places where contagious effluvia are constantly developed, to bathe the hands and arms with its solution.

The chloride of lime has, for some years past, been very generally and most successfully introduced to the stable, the cow-house, and the farm-yard, both as a disinfectant and as a specific for putrid diseases. Youatt, in each of his great works, speaks very highly of its value to the farrier and the farmer; and Clater, in his 'Cattle Doctor,' says respecting it, "In the malignant diseases of cattle, it is exceedingly useful as a lotion, and almost equally so given internally when the disease is beginning to assume a putrid character; but its great value consists in its freeing the stable and the cow-house and the harness from infection of every kind. If they are thor-

oughly washed and scoured with it, there is an end to all danger, whatever may have been the disease. The farmer and the veterinary surgeon will soon appreciate its value in this respect, and never be without it. It is best kept in the form of powder in a closed jar. Half an ounce of it dissolved in a quart of water will give sufficient efficacy to the fluid as a wash; one drachm to the same quantity of water will be sufficient when it is given as a drink." The chief sores, distempers, and diseased conditions of cattle in which it has been proved to be efficacious, are, in external application, garget, blain, foul, sloughing ulcers, and the foeter after abortion, and, in internal exhibition, diarrhoea, dysentery, and malignant epizootics.—Chloride of soda, though hitherto little known in veterinary practice, probably excels chloride of lime both as a disinfectant and as a remedy; but it is liable to be confounded in name with chloride of sodium, or common salt, and ought to be known under its full designation of chloruret of oxide of sodium. Mr. Alcock, speaking of this liquid, says, "It has been shown to possess the valuable property of destroying the most putrid effluvia arising from animal substances, even when these effluvia are diffused to a considerable extent in the surrounding atmosphere: it has also the property, when applied to the substances giving off these effluvia, of arresting or destroying the progress of putrefaction. Not only does it possess this power with regard to dead and detached animal substances, but in those distressing forms of disease in which a part or parts of the living human body become dead and putrid, whilst yet attached to the contiguous tissues which preserve their vitality, it has the inestimable power of speedily ameliorating this most loathsome condition, by destroying the putrid odour emanating from the dead portions; and it, moreover, generally arrests the further progress of decomposition, and promotes the more speedy separation of the dead parts from the living, than can be obtained by ordinary means. It very often is capable of changing the nature of malignant, corroding, and destructive sores, into the condition of simple ulcers: in many ulcers not malignant, it is capable of greatly hastening the cure. In short, though not an infallible remedy, it is capable, under the guidance of medical and surgical skill, sound judgment and experience, of alleviating and often of totally removing, some of the most distressing and loathsome diseases to which animals are liable." A writer in the *Veterinarian* adds to this testimony of Mr. Alcock, "We have used chloride of soda with manifest advantage in a case of fistulous withers, the putrid stage of distemper in dogs, and ulcerations of their lips and gums. A French veterinary surgeon, M. Lard, in the spring of 1805, cured a glandered horse with it; and another military veterinary surgeon, M. Etienne, was most successful in arresting the progress of several diseases among the troop-horses at the bar-

racks of Moulins. The bad forage and situation of this place subjected the horses to attacks of glanders and farcy. Every attempt to arrest these maladies proved abortive, until M. Etienne used the chloride of soda. He diluted the solution of the chloride with twenty-four times its weight of water, and bathed the ulcers with it, and injected it into the nostrils. The defluxion rapidly decreased, and in thirty-five days the animals returned to their work. The usual means of treating these diseases were continued at the same time, but these were perfectly ineffectual before the chloride was used."—The chloride of sodium, or common salt, is universally known as a substance of great and manifold economical value; and it possesses, in addition to its common adaptations, some properties of peculiar worth to the farmer. See the article *SALT*. Chlorine gas is proposed by Mr. Youatt as probably an available and effective agent for destroying worms in the bronchial tubes of cattle.

Chlorine, united with hydrogen, forms an important compound, called *muriatic*, or *hydrochloric acid gas*. See *MURIATIC ACID*. With oxygen, it gives rise to four distinct compounds, which are remarkable for the feeble attraction of their constituent elements, notwithstanding the strong affinity of oxygen and chlorine for most elementary substances. These compounds are never met with in nature. Indeed, they cannot be formed by the direct combination of their constituents; and their decomposition is effected by the slightest causes. Notwithstanding this, their union is always regulated by the law of definite proportions, as appears from the following tabular view, illustrative of their composition.

	Chlorine.	Oxygen.
Protoxide of chlorine,	36	8
Peroxide of chlorine,	36	32
Chloric acid,	36	40
Perchloric acid,	36	56

Chlorine forms, along with nitrogen, one of the most explosive compounds yet known, and was the cause of serious accidents to M. Dulong, its discoverer, and afterwards to Sir H. Davy. The *chloride of nitrogen* is formed from the action of chlorine on some salt of ammonia, chlorine and nitrogen being incapable of uniting, when presented to each other in their gaseous form. Its formation is owing to the decomposition of ammonia (a compound of hydrogen and nitrogen) by chlorine. The hydrogen of the ammonia unites with chlorine, and forms muriatic acid; while the nitrogen of the ammonia, being presented in its nascent state to chlorine, dissolved in the solution, enters into combination with it. The chloride of nitrogen has a specific gravity of 1.653; it does not congeal by the intense cold produced by a mixture of snow and salt. At a temperature between 200° and 212°, it explodes; and mere contact with most substances of a combustible nature causes detonation at common temperatures.

CHLORIS. A genus of grasses, forming the type of the larger portion of the subterminally spiked division of the gramineous family. All the species are exotics; nearly twenty have been introduced to Britain, and about a dozen more are known to botanists. They vary in height from 6 to 15 inches; the greater number are annuals; and about one-half are hardy.

CHLOROFORM. A new therapeutic agent, which is described by Professor Simpson of Edinburgh, as "a dense, limpid, colourless liquid, readily evaporated, possessing an agreeable fruit-like odour, and a saccharine pleasant taste." In its application as an anæsthetic it is inhaled like ether; its advantages over that agent are thus enumerated:—"1. A much less quantity will produce the same effect. 2. A more rapid, complete, and generally a more persistent action, with less preliminary excitement and tendency to exhilaration and talking. 3. The inhalation is far more agreeable and pleasant than that of ether. 4. As a smaller quantity is used, the application is less expensive; which becomes an important consideration if brought into general use. 5. Its perfume is not unpleasant, but the reverse, and more evanescent. 6 and 7. No particular instrument or inhaler is necessary: it is quite portable; and all that is required is to diffuse a little of the liquid upon a hollow-shaped sponge, or even the pocket-handkerchief, and apply the same over the mouth and nostrils, so as to be fully inhaled." It seems capable of being used with great advantage in the more painful veterinary operations as well as upon the human subject. Formyle is the hypothetical radical of formic acid: the acid being so called because it was first observed in the *Formica rufa*, or red ant; but chemists now obtain it from many sources, such as starch, sugar, and most vegetable substances. The perchloride of formyle, or chloroform, may be made by various processes,—“by making milk of lime or an aqueous solution of caustic alkali to act upon chloral: by distilling alcohol, pyroxylic spirit, or acetone, with chloride of lime; by leading a stream of chlorine gas into a solution of caustic potass in spirit of wine, &c.”

CHLOROPHYLLE. The green colouring matter of the leaves and cuticle of plants. It is obtained by bruising and pressing leaves, washing off their proper juices, treating the residue with alcohol, and evaporating the alcoholic mixture to dryness. It appears to be closely akin in constitution to wax. It is soluble in ether, alcohol, oil, or alkali; it is partly soluble in the acetic, sulphuric, and hydrochloric acids, but is precipitated from solution in them by the adding of water; and it is saponified by alkalies, and bleached by light, chlorine, or the acids. Not more than about 100 grains of it are supposed by Berzelius to be diffused over a tree, and to occasion the greenness of all its leaves and shoots.

CHOCOLATE. See CACAO.

CHOKER. A species of cherry-tree. The *Cerasus borealis* is a native of North America, and was introduced to Britain in 1822. It usually attains a height of about 20 feet, and flowers in May and June. The *Cerasus hyemalis* is also a native of North America, and was introduced to Britain in 1805. It seldom grows taller than 4 or 5 feet, and usually flowers in May. Both species are deciduous, hardy and ornamental.

CHOKING. Obstruction in the gullet by unmasticated food. It may occur in any kind of domestic animals, but is most frequent in cattle, and most dangerous in horses. When

potatoes, carrots, parsnips, or turnips are given to cows or horses, without being so minutely sliced as to pass easily down the gullet, some are liable to be swallowed with little or no mastication, and in consequence to stick fast in the throat. The liability is greatly increased if, for the purposes of medicine or of improving the condition, fatty, tarry, or resinous substances, or new-laid eggs, have recently been administered.

A choking animal shows symptoms of great suffering, stretches and labours its neck to bring up the obstructing substance, discharges a profusion of saliva, exhibits a convulsive action of the respiratory organs, soon suffers distension of the abdomen from the accumulation of gas, and, if the obstruction be closely fitted to the sides of the throat, very speedily dies. Coarse, common practice on the farm lifts a cartwhip, a piece of stiffish rope, or even the handle of a rake, and forces or attempts to force the obstructing body down the throat; but this practice, especially in rude hands, and more particularly when so rigid an instrument as the handle of a rake is used, is not a little hazardous, and may inflict very serious evil by both strength and obliquity of pressure. In an extremely bad case, when rapid and excessive distension has occurred, the puncturing of the rumen may be highly advisable, yet this ought, if possible, to be avoided. When the obstruction occurs in the very entrance of the throat, it may be removed either by the hand alone, or by the hand with the aid of a balling-iron; but when it occurs at a great depth down the throat, it ought to be treated with both complication and caution,—first administering half a pint of oil to lubricate the passage, and next introducing the probang, ascertaining whether extraction or forcing-down is likely to be the more successful, and making a series of pulls or pushings till relief be effected. See the article PROBANG. If the stomach be distended, and the obstructing object be forced down, the probang should be allowed to remain for a short time to facilitate the escape of the accumulated gas. When all ordinary methods fail, or when the obstructing object, on being pushed down, sticks fast in the thorax, recourse should be had to the operation of cutting through the skin into the œsophagus; for though this operation is confessedly perilous, it, in this case, affords a hope, which otherwise cannot exist, of saving the animal's life.

CHOKO,—botanically *Sechium*. A small genus of plants, of the cucumber tribe. The eatable species, *Sechium edule*, formerly called *Sicyos edulis*, is a native of the West Indies, and was introduced to Britain in 1816. It is a half-tender, cultivated annual, of 6 or 7 feet in height; and carries a yellow flower in June and July. The fruit is used in the West Indies for fattening hogs.

CHOLESTERINE. The peculiar chemical principle of biliary concretions in man. It very closely resembles spermaceti, both in appearance and in constitution; but it is distinguishable by

not being saponifiable with potash, and by requiring a heat of 278° for its fusion. When cholesterine is decomposed by the action of its own weight of hot concentrated nitric acid, a peculiar substance is deposited, of butyraceous odour, slightly styptic taste, and insoluble in water, called cholesteric acid. Cholesterine has been found also in the biliary concretions of the ox, the pig, and the dog.

CHOREA. A violent convulsive motion in one or more muscles of the limbs. It occasionally, yet very seldom, occurs in the horse. No cure for it is known; but it is not supposed to be attended or followed by worse effects than temporary pain and lameness.

CHORISPORA. A genus of hardy, annual plants, of the cruciferous family. Only four or five species are known; but, though closely allied to the radish genus, they possess little interest. One of them, *Chorispora tenella*, formerly called *Raphanus tenellus*, is sometimes cultivated as an ornamental plant. It was introduced from Siberia in 1780; and it grows 6 or 7 inches high, and carries a purple flower in June and July.

CHORIZEMA, or CHOROZEMA. A genus of beautiful, evergreen, New-Holland undershrubs, of the sophora division of the pea family. Some botanists derive the name from a word signifying to separate, and refer it to the fact of the fruit consisting of two perfectly distinct parts; others derive it from the same word, and refer it to the free or separated condition of the stamens; and others derive it from two words signifying 'dance' and 'drink,' and refer it to the circumstances in which the first plant of the genus was discovered. Three fine species, the dwarf, the holly-leaved, and the rhomb-leaved, were introduced to Britain in 1803; a superb species, *C. Henchmanii*, was introduced in 1824; four beautiful species, *C. triangulare*, *C. ovatum*, *C. cordatum*, and *C. spartioides*, were introduced about 1830 and 1832; and several gorgeous species were introduced by seeds in 1836, and the immediately following years. The various-leaved species, *C. varium*,—called also *C. elegans*, and *C. latifolium*, was introduced, under the name of the Native Pea, from the Swan River in 1837. It has greenish-grey leaves, and splendid racemes of orange and crimson flowers; and, from the very first sowings, it sported into two or three distinct varieties. It grows with much vigour, and is readily propagated from cuttings of its half-ripened shoots. Dickson's species, *C. Dicksonii*, was first raised in this country by Messrs. Dickson of Edinburgh, from seeds obtained in 1836 from the Swan River; and while equal to most of the other species in splendour, it excels them in the size of its flowers. Most of the chorizemas have a height of from 9 to 30 inches; some have a very straggling habit of growth, and, apart from the singular beauty of their flowers, are awkward and unsightly plants; and one or two are so utterly feeble as to succeed best upon such cage-

work as is commonly used for *Tropæolum tricolorum*; but, as a whole, they have already become well-known and highly-prized occupants of the greenhouse.

CHRISTMAS ROSE,—botanically *Helleborus Niger*. A hardy, ornamental, evergreen, herbaceous plant, of the ranunculus tribe. It grows wild in Austria, and in the regions of the Alps and the Apennines, and was introduced to Britain toward the close of the 16th century. Its root consists of many thick, fleshy fibres, which spread far into the ground; its leaves consist of 7 or 8 thick, fleshy, obtuse, slightly-serrated lobes, and have their bases joined to the base of the flower-stems, and lie close to the ground; the flower-stems are naked, rise immediately from the roots, and attain a height of about a foot, each supporting a single flower; and the flowers are large, whitish, and five-petalled, and bloom from January till March. The plant takes its popular name of Christmas Rose from its habit of flowering in winter; it freely blooms in the parterre at a time when scarcely another hardy herb is fully in flower; it is a common favourite in all sorts of flower-gardens, from the most extensive to the mere cottage plot; and it is readily propagated by separating the roots in autumn. A narrow-leaved variety, *H. n. angustifolius*, is much later in flowering than the normal plant, being usually in bloom in March and April.

CHRIST'S THORN,—botanically *Paliurus*. A small genus of hardy, deciduous, ornamental shrubs, of the buckthorn tribe. The common or pointed species, *Paliurus aculeatus*, formerly called *Rhamnus Paliurus*, is a native of Spain, Portugal, Italy, Palestine, and other countries bordering on the Mediterranean, and was introduced to Britain toward the close of the 16th century. It usually grows to the height of about 4 or 5 feet, but may be trained to an upright stem, so as to attain a far greater height, and to send out on all sides numerous slender branches. Two sharp thorns occur at each joint of the branches,—the one straight, upright, and about half an inch long, and the other bent backward, and scarcely one quarter of an inch long; between the thorns is the bud for next year's shoot; the joints go alternately in and out, so as to form at each bud an obtuse angle; and the thorns have a reddish colour, while the bark of the branches is smooth and purplish. The leaves are alternate, oval, pale green, and scarcely an inch in length, and stand on very short footstalks. The flowers have a yellowish colour, are produced in clusters from the sides of the young shoots, appear in June and July, and, though individually small, exist and flourish in such profusion as to make a very good show. The fruit is a two-celled nut, covered by a membrane or berry. This plant takes its name of Christ's Thorn from the supposition that it was the plant of which the crucifiers of the Lord of Glory formed his ignominious crown of thorns. The word translated "thorns" in the sacred nar-

rative is quite general, and was fitted to designate all or any of the numerous thorny plants which grow in Palestine; yet the *Paliurus aculeatus* is fully as likely as any of these plants to have furnished the actual thorns of the crucifixion. Hanbury reasons away all doubt from his mind on the subject, and with well meant piety concludes, "These plants, therefore, should principally have a share in those parts of the plantation that are more peculiarly designed for religious retirement; for they will prove excellent monitors, and conduce to due reflection on and gratitude to 'Him who hath loved us, and washed us from our sins in his own blood.'"—The twiggy species, *Paliurus virgatus*, called by some botanists *Zizyphus incurvus*, is rather taller than the common species, blooms in August and September, and was introduced about 30 years ago from Nepaul.

CHROMIUM. A simple or undecomposable mineral substance, of a metallic nature. It was discovered in 1797 by Vauquelin, and received the name of Chromium, from a Greek word signifying colour, in allusion to its great tendency to form coloured compounds. It naturally occurs in a beautiful red mineral, the dichromate of lead, and in a compound of the oxides of chromium and iron, called chromate of iron. It has a yellowish white colour, and a distinct metallic lustre; it is brittle, easily reduced by heat, and difficult of attack by acids; it has a specific gravity of something between 5 and 6; and it becomes converted first into green oxide, and next into chromic acid, when fused with nitre. The principal compounds of chromium are salts of its oxide with alkalies, salts of its acid with alkalies and metals, three fluorides of chromium, a sulphuret, and a phosphuret. One of the salts of its acid, chromate of lead, has a rich yellow colour, and is of great importance and extensive use in the arts of painting and dyeing.

CHRYSALIS. The pupa of a lepidopterous insect. Every larva of a butterfly or a moth, or in other phrase, every caterpillar, becomes a chrysalis before arriving at its final condition. See the articles **CATERPILLAR** and **BUTTERFLY**. A chrysalis is at first very soft, but afterwards hardens; and it then sinks into a torpid condition, and remains in it till the time arrives for its transformation. Its period of duration, in each species, varies according to the state of the temperature, or the mildness of the weather, being retarded by cold, and accelerated by heat. When the insect has all ceased to be chrysalis, or all attained to be moth or butterfly, except the skin or enveloping sheath, it bursts from this integument, and emerges feeble and languid, with crumpled wings, but speedily becomes active and excursive, retaining not a vestige of either the torpor or the outward form of its chrysalis condition.

CHRYSANTHEMUM. A genus of ornamental plants, of the chamomile division of the composite family. Two species grow wild in Britain; about thirty have been introduced from foreign coun-

tries; and nearly twenty more are known to botanists. Three species, the pinnatifid, the anomalous, and the rooting, are white-flowered, greenhouse undershrubs from Spain and Madeira; two, the tripartite and the Chinese, are herbaceous evergreens, with various-coloured flowers; three are hardy annuals, and two hardy perennials, with yellow flowers; and all the others are hardy herbs, either annual, evergreen, or perennial-rooted, with white flowers. But almost all the practical interest of the genus, whether for its annoyances or for its attractions, is concentrated in the two indigenous species and the Chinese species.

The corn chrysanthemum, *C. segetum*, is one of the best known, most conspicuous, and most annoying weeds of the corn fields of Britain. It is a prevalent and abundant yellow-flowered annual; and is known, in general popular language, as corn marigold,—in Kent, as yellow-bottle,—in Norfolk, as budland,—in the midland counties of England, as golds or gowls,—in the north of England, as goldens and gules,—and in Scotland, as gule, gules, gule-gowans, and yellow-gowans. Its root is tapering and fibrous; its stem is round, stiff, ramose, and from 18 to 26 inches high; its leaves are bluish-green, long, very broad, narrowest at the base, and deeply indented at the sides; and its flowers are yellow and brilliant, have a broad, open disc, and bloom from June till August. An old method of subduing this troublesome though showy weed, was to manure the land in autumn, to lay it out to summer fallow, and to harrow it about five days after sowing; but at once the easiest, the most economical, and the most successful method of attempting its extermination is to pull it up or cut it down by hand as soon as it comes into flower.

The ox-eye daisy, *Chrysanthemum leucanthemum*, is a herbaceous evergreen, quite as generally known as the corn chrysanthemum, but contributing far more to ornament and utility than to mischief. It is called sometimes the moor daisy, sometimes the great white ox-eye maudlinwort, and sometimes simply ox-eye. It abounds in our pastures and grass fields, and by the sides of our by-roads and less frequented public-roads; and is often a conspicuous and pleasant feature of the concluding part of summer. Its root is woody, tough, branched, and profusely fibrous; its stem is erect, about two feet high, and sometimes simple, sometimes branched; its radical leaves are obovate, stalked, and deep green; its other leaves are oblong, obtuse, cut, pinnatifid at the base, and sessile or rather embracing the stem; and its flowers are terminal, solitary, large, and open in their form, with yellow disc and brilliant white rays, often far excelling in beauty some of the favourites of the parterre, and usually blooming in June and July. The whole plant is softly herbaceous, and slightly but not agreeably aromatic; and

when it grows on meadows or among the artificial grasses, it forms part of the hay crop.

The Chinese chrysanthemum, *C. sinense*, was introduced to Britain from China first in 1764, and afterwards, in numerous varieties, throughout a series of years. In its natural state, however, or with character unchanged by cultivation, it seems never to have been introduced; for though many varieties, quite distinct from one another, have been imported, all were purchased from the Chinese traders, in the markets of Macao. It is a herbaceous evergreen, of usually about 4 feet in height; its leaves are bluish-green, broad, deeply and sharply serrated and lacerated; and its flowers, in general, consist of large, matty, circular adjustments of ligulate florets,—these, in the numerous varieties, being of almost every colour except blue, and frequently combining, in one variety, a showy and imposing mixture of colours. This plant engages much of the attention of florists, and generally occupies a large place in tolerable collections of flowering plants; yet it has a coarse, rank, lanky appearance in vegetation, and possesses little or no delicacy and very rarely any good form in its flowers, and owes its power of pleasing partly to the mere colour of its flowers, and principally to its habit of flowering throughout a period of the year when almost all other conspicuously flowering plants are deep in the sleep of winter. In its native country, it blooms from the beginning of November till the end of February or the middle of March; and in spite of all artificial appliances to modify or alter its habits, it stubbornly adheres to this season of flowering in Britain. While azaleas, camellias, magnolias, and other Chinese winter-flowering plants can, by proper artificial treatment, be either greatly retarded or greatly accelerated in showing bloom, the Chinese chrysanthemum, whether situated in the greenhouse or in the open ground, and whether raised from seeds, from layers, or from cuttings, completes the annual cycle of its secretions at exactly one period, and commences its attempts to bloom in the early part of December. But this physiological peculiarity, while insuring for florists a profusion of showy flowers in a mild or open winter, sometimes occasions their sad disappointment, and puts their appliances of protection grievously at fault, under an early commencement of severe frost.

The varieties of Chinese chrysanthemums in cultivation even twenty years ago were exceedingly numerous; and they have since been greatly multiplied by importations and hybridizements. A classified list of the older and best known sorts, in the Transactions of the London Horticultural Society, distributes them into four groups,—plants having large and showy flowers and requiring protection, quite hardy plants with large and showy flowers, scantily-flowering plants with large and showy flowers, and plants which, from either the lateness or the smallness of their

flowers, are not deserving of cultivation. The varieties which have large and showy flowers but require protection, are the superb white, the paper white, the sulphur yellow, the golden yellow, the curled lilac, the curled blush, the semidouble quilled pink, the starry purple, the early crimson, the pale-flamed yellow, the tasselled white, the semidouble quilled white, the quilled flamed yellow, the tasselled lilac, the large lilac, the blush ranunculus-flowered, the brown purple, the two-coloured red, and the pale buff; the quite hardy varieties with large and showy flowers are the quilled white, the superb-clustered yellow, the changeable white, the tasselled yellow, the golden lotus-flowered, Park's small yellow, the rose or pink, the purple, the buff or orange, the small yellow, the early blush, the pale pink, the changeable pale buff, and the Spanish brown; the scantily-flowering varieties with large and showy flowers are the semidouble quilled orange, the expanded light purple, the large quilled orange, the quilled light purple, and the two-coloured incurved; and the varieties which, from either the lateness or the smallness of their flowers, do not deserve to be cultivated, are the double Indian white, the yellow warratah, the Windsor small yellow, the quilled salmon coloured, the semidouble quilled pale orange, the late pale purple, the double Indian yellow, the late quilled yellow, the quilled yellow, and the quilled pink.

The best soil for Chinese chrysanthemums is a mixture of turfy loam and peat, or a mixture of ordinary loam and leaf-mould. "When they have advanced in growth considerably, and got lanky before they show their bloom, the top three joints must be taken off; and, with the aid of bottom-heat, under a hand-glass, shaded from the sun, these tops may be struck rather rapidly. When potted out, they may be placed upon some hard floor out of doors, where the worms cannot get through into the pots, and there left to grow themselves up to the blooming point; they will be found very dwarf, and may be shifted from their first to their second pots, and removed under a frame, or into the greenhouse, to perfect their flowers. The old roots, or rather old stools, may be turned out into the open ground to grow stock for propagation, or perfect their flowers as garden or border ornaments. The depriving them of their tops makes them push side shoots, which bloom in a late season, or which may be again taken off and struck. After blooming, the plants may be cut down completely, and when they shoot from the bottom, the plants may be parted, to go through the same operation the next year."

CHRYSEIS, or ESCHSCHOLTZIA. A genus of hardy, herbaceous, ornamental plants, of the poppy family. This genus was discovered by Menzies in Vancouver's voyage, and might have been appropriately called *Menziesia*, had not that name been pre-occupied by a genus of heaths. The name *Chryseis* is borrowed from one of

Homer's beauties, and alludes to the bright golden colour of the flowers; and the name *Eschscholtzia* is in honour of the botanist Eschscholtz, who accompanied Kotzebue in his voyage round the world. The latter of these names, besides being almost unpronounceable, was pre-occupied, in the milder form of *Elsholtzia*, by a genus of the labiate family, and ought therefore to be discontinued. The Californian species, *Chryseis Californica*, was introduced to Britain from California in 1826; and two other species, *C. crocea* and *C. compacta*, have since been introduced from the same country. But the three species differ from one another only in minute features, and possess so nearly a common character as to have been very generally regarded as mere varieties. All are brilliant, very handsome, and well worthy of cultivation; all have a creeping habit, brittle stems, and golden-coloured flowers; and all, though ranking with some botanists as biennials, and with others as tuberous-rooted perennials, are capable of as prompt, facile, and hardy cultivation, as the least fastidious and most rapidly flowering of the common hardy annuals. The Californian species is already to be seen in multitudes of the smallest class of parterres, and well deserves all the popularity it has so rapidly attained. The saffron-coloured species is distinguished from the Californian almost solely by the tint of its flowers; and the compact species, by the comparative smallness of its flowers, and by having the segments of its leaves very slightly toothed, instead of deeply lobed.

CHRYSOBALANUS. See COCOA PLUM.

CHRYSOCOMA. See GOLDBLOCKS.

CHRYSOPHYLLUM. See STAR-APPLE.

CHRYSURUS. A small genus of hardy, annual grasses, of the dog's-tail-grass tribe. The hedgehog species, *C. echinatus*, grows wild on the sandy fields of England. It has a height of 2 or 2½ feet, and flowers in August, but has a weedy character. The elegant species, *C. elegans*, but esteemed by some botanists a *Cynosurus*, was introduced from the south of Europe in 1816, grows a foot high, and has a handsome appearance. Two other species are known, and have been introduced.

CHYME, in animal economy. In the process of digestion, the food is subjected to a temperature usually above 90° of Fahrenheit. It is mixed with the gastric juice, a liquor secreted by the glands of the stomach, and is made to undergo a moderate and alternate pressure, by the contraction of the stomach itself. It is thus converted into a soft, uniform mass, of a greyish colour, in which the previous texture or nature of the aliment can be no longer distinguished. The *chyme*, as this pulpy mass into which the food in the stomach is resolved is termed, passes by the pylorus into the intestinal canal, where it is mixed with the pancreatic juice and the bile, and is still exposed to the same temperature and alternating pressure. The thinner parts of

it are absorbed by the slender tubes termed the *lacteals*. The liquor thus absorbed is of a white colour; it passes through the glands of the mesentery, and is at length conveyed by the thoracic duct into the blood. This part of the process is termed *chylification*, and the white liquor thus formed *chyle*. It is an opaque, milky fluid, mild to the taste. By standing for some time, one part of it coagulates; another portion is coagulated by heat. The chyle, after mixing with the lymph conveyed by the absorbent vessels, is received into the blood, which has returned from the extreme vessels, before this passes to the heart. All traces of it are very soon lost in the blood, as it mixes perfectly with that fluid. It is probable, however, that its nature is not immediately completely altered. The blood passing from the heart is conveyed to the lungs, where it circulates over a very extensive surface presented to the atmospheric air, with the intervention of a very thin membrane, which does not prevent their mutual action. During this circulation, the blood loses a considerable quantity of carbon, part of which, it is probable, is derived from the imperfectly assimilated chyle, as this, originating in part from vegetable matter, must contain carbon in larger proportion than even the blood itself. See the article NUTRITION.

CHURN. A machine for separating the butyraceous matter from cream or milk, and, in consequence, making butter. Churns are exceedingly various in size and construction, and considerably diversified in the kind of power by which they are worked, and the manner in which that power is applied.

The plunge-churn worked by hand is the simplest, and was, for a long time, the most common; but, in almost all dairies except those of mere cottages, it has been completely superseded. It consists of an upright, wooden, cylindrical vessel; a lid or cover, with a small central aperture; and a long moveable handle, inserted through this aperture, and terminating in a circular and plentifully perforated board, of a size nearly to fit the cylinder, and yet to admit of being freely moved up and down among the cream or milk. The simple perpendicular motion of the handle, playing constantly up and down like a piston, abundantly agitates the cream or milk by means of the perforated board; but the process is both laborious and somewhat tedious.

The barrel-churn consists of a wide cylinder or unbulged barrel, mounted horizontally upon a frame; an axle inserted through the centre of the barrel, from end to end; fans or arms, attached lengthwise to the axle, just broad enough to revolve within the barrel, and constituting with the axle a kind of fan-wheel; and external appliances, principally a toothed-wheel and a fly-wheel, for putting and maintaining the fly-wheel in revolving motion. A short horizontal handle is attached to one of the spokes of the fly-wheel; and a single person, by keeping hold of this and

turning the fly-wheel, easily and speedily effects a churning.—The box-churn is the same in general construction, in position, and in mode of working, as the barrel-churn, but is four-sided while the latter is cylindrical.—The upright barrel-churn has a vertical position; it is provided, on the exterior of its upper end, with a small cylindrical rope-coil, set in a frame or cross-bar; the rope which plays round the coil passes through holes in the sides of the frame or cross-bar, and is firmly attached to treadle-boards, which are situated close to the churn, and on a level with its lower end; and a man, by standing on the treadle-boards, and alternating his weight on the right foot and on the left, causes the fan-wheel to move vertically and rapidly, in a constant series of alternate directions, and, in consequence, effects a churning with comparatively great ease and speed.—A cradle-churn is shaped somewhat like a cradle, but mounted on a wooden frame, and provided internally with a grate or grates in the centre, to slide in a groove; and it is rocked with regular motion, not faster than the pendulum of a clock, and serves remarkably well for making butter.—An example of the American cradle-churn is incidentally noticed as follows in Lambert's Travels through Lower Canada and the United States:—"At a farmer's near Lake Champlain, we saw a machine for churning butter. It was a kind of half-barrel, with a place where one of the farmer's sons sat astride as on horseback. The machine, moving up and down, answered the double purpose of a churn for making butter, and a rocking-horse for his children."

In large dairies, or on large farms, churns are so constructed and situated as to be worked by machinery; and in some cases, this is driven by a horse or an ass or by the separate application of water-power, and, in other cases, by the same power which drives the machinery of a threshing-mill or a scutch-mill. The construction of churn generally preferred for working by machinery is that of the plunge-churn; it has the shape and position of an upright, unbulged barrel, and may have a capacity of from 40 to 200 gallons; the perforated board or dasher, for agitating the cream or milk, is moved up and down by a lever; and this is connected with the motive machinery and power by means of a shaft and crank. Churns of this construction can be accommodated to wide gradations in the quantity of milk, simply by the addition of holes or screws for regulating or altering the distance of the churn-staff from the centre of the lever. An excellent variety of plunge-churn for working by machinery is figured and described in Low's Elements of Agriculture; and models of two varieties, the one with a vertical plunge, and the other double, square, and with horizontal plunges, are shown in the museum of the Highland Society, and briefly noticed in its catalogue.

CHYMOCARPUS. A small genus of orna-

mental, climbing, herbaceous, greenhouse plants, of the tropæolum tribe. The five-leaved species, *C. pentaphyllus*, called by Lamarck *Tropæolum pentaphyllum*, was first raised in Britain in 1830, from seeds obtained from Buenos Ayres. It attains a height of about 4 or 5 feet, blooms from August till October, and has beautifully variegated flowers of red and green and purple. Its flowers differ from those of the tropæolum genus in being two-petalled; and its fruit is a juicy black berry, somewhat like the Zante grape. The generic name, chymocarpus, alludes to the chief character of the berry, and signifies "juicy fruit."

CIBOULES. See **ONION**.

CICCA. A small genus of evergreen, tropical, fruit-trees, of the spurge tribe. The two-rowed-leaved species, *C. disticha*, was introduced from India toward the close of last century. It usually attains a height of about 20 feet. Its flowers are green; and its fruit are about the size of large marbles, roundish, acidulous, and well adapted for tarts.

CICER. See **CHICK-PEA**.

CICHORIUM. See **SUCCORY** and **ENDIVE**.

CICUTA. See **COWBANE**.

CIDER. See **CYDER**.

CIMICIFUGA. See **BUGWORT**.

CINDERS. See **ASHES**.

CINERARIA. A large genus of beautifully flowering plants, of the jacobea division of the composite order. Two species grow wild in England, about 60 species have been introduced from foreign countries, and a great number of hybrids have been raised by British florists, and are sold in our public nurseries. Four or five of the species have one-flowered peduncles, and all the others have many-flowered peduncles; and about one-half of the latter are tender, evergreen undershrubs, of from one foot to four feet in height, with leaves somewhat like those of the avens genus,—while the remainder are perennial herbaceous plants of from 6 inches to 5 feet in height, chiefly deciduous and hardy, and all with leaves somewhat like those of coltsfoot. The marsh species, *C. palustris*, grows wild in the marshes of England, has a height of about a yard, and carries yellow flowers in June and July. The entire-leaved species, *C. integrifolia*, grows wild in the chalky pastures of England, has a height of 6 or 8 inches, and carries yellow flowers in May and June. These two species are strictly weeds, but confine themselves to a very limited range of soil; and were the most brilliantly flowering species of the greenhouse to be hardy and diffused enough to grow and cast their winged seeds in the open ground, they would speedily become as annoying to the farmer as thistles or groundsel. The vast majority of the species, in their natural state, are yellow-flowered, and have but a shabbily ornamental character, only a degree or two superior to that of dandelion; but a few of the choicer species, and very many of the hybrids, are, as to mere colour and

tint, the most brilliant and dazzling tenants of either the greenhouse or the parterre. Intense blue, shaded off to all tints and gradations of blue, lilac, and purple,—crimson of all shades, up to pale rose,—party-colours of all shades, pure white centres, darkish disks, light-coloured disks, with many varieties of margin,—all these occur in cinerarias, and have combined with nearly circular form and with flat and spatulate florets, to win for these plants, not only popularity, but great multiplicity and prominence.

The woody species of cineraria are readily propagated from cuttings, the herbaceous species by division of the roots, and both classes from seeds, and by the rooting of the side-shoots. Seed intended for sowing should be well separated by being rubbed in a little sand or dry sifted soil; and should be thinly sown, in April or May, in boxes, pots, or seed-pans, filled with fine light soil, or with a sifted compost of equal parts of peat and turfy loam. The boxes, pots, or pans should be kept in a frame, and occasionally watered. When the seedlings appear, they ought, for a few days, to be lightly shaded from the sun with a covering of thin calico, white paper, or any similar material; when they have attained a little size and strength, they should be pricked out, and set near the edges of pots; and in August or September, they should be planted singly in pots, filled one-third with crocks and pieces of charcoal, and two-thirds with proper soil, and placed in a pit or a dry frame, there to stand throughout the winter. In early spring, they will begin to flower; and, for the sake of their bloom, they may be removed to any situation where they are wanted. Seeds from these plants will produce improved plants, and again seed from the latter will produce plants still more improved; but any of the plants, if simply earthed up, will speedily form rooted side-shoots, which require merely to be separated in order to grow and bloom as independent plants. When cuttings are used for propagation, they should be taken small, and struck in sand under a bell-glass. Cinerarias require a very free ventilation, and are always weakened in organism and damaged in bloom by the application of forcing heat.—Two herbaceous species of respectively marigold and centaury are popularly called cinerarias; and a number of species formerly included in the genus cineraria, are now assigned to four other genera.

CINNA. A small genus of grasses, of the agrostis tribe. Only two species, and these of small interest, are known. The reedy species, *C. arundinacea*, was brought from Canada, and grows about a yard high.

CINNABAR. A mineral, composed of one equivalent of mercury and two equivalents of sulphur. It is heavy, and has a dark red colour; but it is sometimes prepared artificially,—and it then bears the name of factitious cinnabar, and is intimately allied to the well-known beautiful pig-

ment, vermilion. Cinnabar is not attacked by alkalies or simple acids, but is dissolved and decomposed by nitro-muriatic acid. It was formerly administered to horses, in doses of half an ounce daily, as an alterative in obstinate coughs and thickness of wind; but it has now almost ceased to be used by farriers.

CINQUEFOIL,—botanically *Potentilla Reptans*. A creeping, perennial, herbaceous plant, of the rosaceous-flowered tribe. It abounds in meadows and pastures, and by the waysides, particularly on dry sandy soils, in most districts of Britain. Its root is comparatively long and large, and was formerly used as an astringent in medicine; its stems are round, smooth, reddish, decurrent, and stoloniferous, in the manner of those of the strawberry plant; its leaves are long, narrow, and indented, and are arranged digitatively and five in number on each footstalk, so as to give occasion to the name of cinquefoil; and its flowers are large and bright yellow, stand upon long footstalks, and appear from June till September. The other British species of potentilla, and even the whole of that great genus, are sometimes called cinquefoil. See the article **POTENTILLA**.

CINQUEFOIL (MARSH),—botanically *Comarum*. A curious, evergreen, herbaceous plant, of the rosaceous-flowered tribe. It was formerly ranked among the potentillas; but now constitutes a genus of itself. It grows wild in our spongy bogs and ditches; its root is creeping and very fibrous; its stems are round, reddish, and about 18 inches in height; and its flowers are an inch broad, of a purplish blood colour, and very showy, and appear in June and July.

CIRCULATING SYSTEM. We have stated, in our article **ANIMAL**, that the second characteristic peculiar to animals, as distinguished from plants, is that of possessing a circulating system. If we commence from the arachnides, or spiders, and the worms, and then examine all animals higher in the scale of creation, it will be found that the nutritive fluid circulates through a system of cylindrical vessels; and that it only supplies the several parts requiring nourishment by means of their ramified extremities, or lacteals, through which the nutriment is deposited in the places requiring sustenance. These vessels, which distribute the nutritive fluid or blood to all parts of the body, receive the name of *arteries*. Those, on the contrary, are called *veins*, which restore the blood to the centre of the circulating system. This motion of the nutritive fluid is sometimes performed simply in one circle; often there are two circular motions, and even three, if we include that of the *vena-portæ*, which collects the blood of the intestines, and conveys it to the liver. The velocity of its motion is frequently assisted by certain fleshy organs called *hearts*, which are placed at some one centre of circulation, often at both.

In the vertebrated and red-blooded animals, the nutritive fluid, or chyle, leaves the intestines

either white or transparent; and is conveyed into the venous system, by means of particular vessels called lacteals, where it mixes with the blood. Other vessels similar to the lacteals, and composing with them one arrangement, called the lymphatic system, convey into the venous system those nutritive particles which have either escaped the lacteals, or have been absorbed through the cuticle or outer skin. Before the blood is fitted to renovate the substance of the several parts of the body, it must receive, from the surrounding element, through the medium of respiration, that modification which we have already noticed. One part of the vessels belonging to those animals, which possess a circulating system, is destined to convey the blood to certain organs, where it is distributed over a large extent of surface, in order that the action of the surrounding element may be the more energetic. When the animal is adapted for breathing the air this organ is hollow, and called *lungs*; but when the animal only breathes the air dissolved in water, the organ projects, and is called *branchiæ*, or *gills*. Certain organs of motion are always arranged so as to draw the surrounding element either within or upon the organ of respiration.

In animals which do not possess a circulating system, the air penetrates into every part of the body, through elastic vessels called *tracheæ*; or else water acts upon them, either by penetrating, in a similar manner, through vessels, or simply by being absorbed through the surface of the skin. In man, respiration is performed by means of the pressure and elastic force of the air, which rushes into the lungs, where a vacuum would otherwise have been formed by the elevation of the ribs, and the depression of the diaphragm. Muscular force then expels the air, after the necessary purification of the blood existing in the lungs has been performed; and the same actions are again repeated. The blood, which was of a dark purple colour, while slowly travelling from all parts of the body to the heart, has no sooner been purified by yielding its excess of carbonic acid to the surrounding air, and by absorbing oxygen, than its colour changes into a bright vermilion. In birds, it was necessary to combine lungs of small bulk with an extensive aeration of the blood; and, accordingly, the blood not only passes into the lungs, but through them into capacious air cells; from which, by the action of the chest, it is again expelled. The lungs thus act twice upon the same portion of air. The change of the tadpole into the frog is accompanied by extraordinary alterations in its respiratory organs. In the first, or tadpole state, the organs are branchial, in the frog they are pulmonary. The arrangements are striking and singular.

All respiration must be either *aquatic* or *atmospheric*. In the former case, the respiration is said to be *cutaneous* or *branchial*, according as it is performed through the skin or through gills. On

the other hand, atmospheric respiration may be either *tracheal* or *pulmonary*, according as it is performed through the air-tubes called *tracheæ*, or by means of lungs.

After the blood has been purified by respiration, it is fitted to restore the composition of all parts of the body, and to execute the function of nutrition properly so called. The wonderful property, possessed by the blood, of decomposing itself so as to leave precisely, at each point, those particular kinds of particles which are there most wanted, constitutes the mysterious essence of vegetative life. We lose all traces of the secret process by which the restoration of the solids is performed, after having arrived at the ramified extremities of the arterial canals. But in the preparation of fluids we are able to trace appropriate organs, at once varied and complicated. Sometimes the minute extremities of the vessels are simply distributed over extended surfaces, from which the liquid exudes; and sometimes the liquid runs from the bottom of minute cavities. But the more general arrangement is, that the extremities of the arteries, before changing into veins, form particular vessels called *capillary*, which produce the requisite fluid at the exact point of union between these two kinds of vessels. The blood-vessels, by interlacing with the capillary vessels which we have just described, form certain bodies called *conglomerate* or *secretory glands*.

With all animals destitute of a circulation, and especially with insects, the nutritive fluid bathes the solid parts of the body; and each of them imbibes those particles necessary for its sustenance. If it become requisite that any particular fluid should be secreted, capillary vessels, adapted for this purpose, and floating in the nutritive fluid, imbibe, through their pores, the elements necessary for the composition of the fluid to be secreted. It is thus that the blood continually renovates all the component parts of the body, and repairs the incessant loss of its particles, resulting necessarily from the continued exercise of the vital functions. The general idea which we are able to form of this process is sufficiently distinct, although the details of the operations performed at each particular point are involved in obscurity, from our ignorance of the precise chemical composition of each part, and our consequent inability to determine the exact conditions necessary for their reproduction.

CIRSIUM. A large genus of hardy herbaceous plants, of the thistle division of the composite order. It comprises the greater portion of the old genus *cnicius* or plume-thistle, about a dozen species which were formerly included in the genus *carduus* or true thistle, and a large number of species peculiarly its own. The total number of its species is nearly one hundred; and the number of its indigenous species is eight. Some of the latter are excessive pests on poor soils and badly cultivated lands, and are well and sorrow-

fully known to many a farmer. See the article THISTLE (PLUME.)

CISTERN. A small artificial reservoir of water. It is practically the same as a tank, and differs only in mode of construction, or even in mere name.

CISSUS. A large genus of tropical, climbing plants, of the vine tribe. About eighty species have been scientifically described; and upwards of one-third of these have been introduced to our hothouses. Almost all the species are nearly identical with the vine in botanical characters, and very closely akin to it in habit; but only a few of them have a good appearance, and scarcely any are of considerable utility. The small leaves and quadrangular stems of *Cissus quadrangularis*—which grows to a height of about 30 feet, and was introduced to Britain in 1790—are sometimes eaten by the natives of India, and, when dried and powdered, are prescribed by the Tamul physicians in some diseases of the stomach and bowels.

CISTUS. A genus of beautifully-flowering, evergreen shrubs, forming the type of the order Cistaceæ or Cistineæ. This order comprises four genera, and has, within the gardens of Britain, nearly 200 species. Almost all the species are remarkable for the beauty of their flowers; and the greater number are admirably adapted for rock-work. They are distinguished from other calycose plants, always by their alternate or opposite undivided leaves, and generally by their exuding a fragrant resinous secretion, and by their having regular flowers with crumpled petals.

About forty species of the cistus genus, besides some varieties, have been introduced to Britain; and all, for the sake of their handsome, fragrant, evergreen foliage, and especially of their elegant flowers, are worthy of general and zealous cultivation. Two were brought from the Atlantic islands of Africa, and all the others from countries bordering on the Mediterranean. All are usually called hardy; but some require the protection of mattings, or cold frames,—or, though resisting the bad effects of ordinary winters, are liable to be destroyed by either a severe or a prolonged frost. All thrive best upon rocky soil, or in a mixture of sand and peat, or of sand and loam; and can be propagated either from seeds, by layers, or by cuttings,—the last taken off in June or July, and planted under a hand-glass. Nearly one-half of the species have rose-red or purple flowers, and most of the remainder have white flowers, with beautifully purple-stained or purple-spotted centres. The flowers of some are as large as a medium-sized rose; and those of most are strictly ephemeral, or continue during only part of a day, but appear in constant and profuse succession during the months of June and July. Some of the species frequently, and all of the species occasionally, bear the popular name of rock-rose; and three or four of the

most gummiferous, fragrant, and beautifully-flowered, particularly *C. ladaniferus*, *C. Ledon*, *C. undulatus*, and *C. cyprius*, are popularly called Gum-Cistuses. The gum ladanum of commerce is produced by *C. ladaniferus* and *C. Ledon*, but still more copiously by *C. creticus*; and in Candia, it is scraped from the leaves and stems, by means of a kind of leather-toothed or leather-thonged rake, called *ergatiri*. In the time of Dioscorides, goats were set to browse upon the foliage; and when they had collected the gum upon their beards, their owners removed it thence by combing. We shall briefly notice four or five of the most conspicuous or best known species, as specimens of the whole.

The ladanum-bearing species, *C. ladaniferus*, was introduced to Britain from Spain in the third decad of the 17th century. Its stem is woody, and has a height of about four feet; its branches are irregularly produced, yet usually form the plant into a well-shaped bush; its leaves are lanceolate, odoriferous, smooth, and finely green above, and veined and whitish below; and its flowers are very large, very delicate, well formed, and beautifully tinted, and are produced in plenty all over the shrub. Many varieties of this species exist, differing from one another principally in the colour or tinting of their flowers; but most of these are referrible to two types, the white-flowered and the spotted, or *C. l. albiflorus* and *C. l. maculatus*. The waved and the Cyprus species have sometimes been confounded with the ladanum-bearing species.—The poplar-leaved species, *C. populifolius*, was introduced from Spain about the middle of the 17th century. Its stem has a height of from 3 to 6 feet; its branches grow irregularly, and are covered with a brown bark; its leaves are cordate, pointed, and smooth; and its flowers are white and numerous, and grow at the ends and sides of the branches.—The bay-leaved species, *C. laurifolius*, was introduced from Spain in 1731. Its stems attain a height of from 4 to 6 feet; its leaves are oval, pointed, deep green above, whitish below, and, during part of the year, very clammy; and its flowers are white, large, numerous, and imposing.—The hoary species, *C. incanus*, was introduced from the south of Europe toward the close of the 16th century. Its stem has a height of from two to four feet, and ramifies into a bushy head; its leaves are sessile, rough, hoary, and of different shapes and sizes according to the variety, or even on the same plant; and its flowers have a purple colour, of greater or less intensity according to the variety.—The Montpellier species, *C. monspeliensis*, was introduced from the south of Europe in 1656. Its stem has a height of from two to four feet; its branches grow numerous from the lower as well as the upper part of the stem, and are hairy, tough, and slender; its leaves are sessile, lanceolate, dark green, hairy, longitudinally three-veined, and very clammy and fragrant; and its flowers are white

and numerous, and are produced, on long footstalks, at the ends of the branches.—The other species most commonly cultivated are those designated *appenninus*, *albidus*, *grandiflorus*, *crispus*, *helianthemum*, *alpestris*, *Italicus*, *algarvensis*, *laxus*, *proliferus*, *halimifolius*, *salvifolius*, *roseus*, *marifolius*, *mutabilis*, and *surrejanus*.

CITRIC ACID. The peculiar acid of many acidulous fruits, particularly of the juice of limes, lemons, oranges, and currants. It is believed to be the active principle which renders these fruits so powerfully antiscorbutic; and it has sometimes been recommended, in the room of lemon-juice, as a preventive of sea-scurvy. It has a cooling and grateful effect, as an ingredient in drinks; yet it probably acts with most benign effect, especially in counteracting the putrefactive tendency of animal food, when used in its natural state of combination with the sugar, mucilage, and extractive of fruits. It is obtained in a separate state by adding finely pulverized chalk to lemon-juice, so as to form insoluble citrate of lime,—by washing this citrate with water, and decomposingly digesting it in diluted sulphuric acid,—by infiltrating the liquid from the insoluble sulphate of lime,—and by evaporating the liquid to dryness, so as to drive off all the water, and leave the citric acid as a residuum. The acid crystallizes into large transparent rhomboidal prisms; it consists of four equivalents of carbon, four of oxygen, and two of hydrogen; it keeps for any length of time undecomposed in dry jars or bottles, but is slowly and gradually decomposed when damp or in watery solution; and it is convertible into the highly poisonous oxalic acid, by the action of nitric acid. The principal salts formed by it are the citrates of potash, soda, ammonia, magnesia, lime, iron, baryta, and strontia; but—excepting the first, which is often extemporaneously made in solution as an effervescing draught—they are of very small importance.

CITRUL. See CUCUMBER.

CITRUS. A very rich and important genus of tropical fruit-trees, containing the type of the order Aurantiacæ. It is distinguished from the other genera of this order, by the multitudinousness and irregularly parcelled combination of its stamens, and by the looseness with which the leathery rind of its fruit is attached to the enveloped bags of pulp. Fifteen species, besides varieties, all ranking as cultivated tropical fruit-trees, are enumerated by some botanists; but these are referred by other writers to four types or specific sources,—all the kinds except these four being regarded as either natural varieties or artificial hybrids. Full notices of the whole, or of the several groups and most important kinds, will be found in our articles AURANTIUM, ORANGE, LEMON, CITRON, LIME, MANDARIN, and SHADDOCK.

CIVES. See CHIVES.

CLARKIA. A small genus of very beautiful, hardy, annual plants, of the order Onagraricæ.

The elegant species, *Clarkia elegans*, was introduced from California in 1832. Its stem is erect, and between two and three feet high, and sends off numerous, erect, twiggy, rounded, glabrous, leafy branches; its leaves are ovate, acute, glabrous, and more or less distinctly toothed, and stand on short footstalks; and its flowers have four equal, spreading, somewhat rhomboidal, clawed, and deep rose-coloured petals, stand out horizontally, are quite sessile, and bloom from July till the end of autumn. A variety of this species has double flowers, of a palish rose colour.—The gaura-like species, *Clarkia gauroides*, was introduced from California in 1834. Its stem is erect, filiform, pale green, stained with purple, clothed with pubescence, much branched, and about a foot high; its leaves are alternate, stalked, ovate, acute, entire, an inch long, dark green and glabrous above, and paler and pubescent below; and its flowers are scattered in terminal racemes, begin to bloom in August, and have four purple petals, with very short claws, and rhomboidal, obtuse, concave, crenulately repand laminae, furnished just above the claw with two short auriculate lobes.—The pretty species, *Clarkia pulchella*, was introduced from the territories of the Hudson Bay Company in 1826; and is already in so general favour, that it may be seen in every garden, from the tiniest to the most noble, in which the slightest taste or knowledge of plants is displayed. It has a height of about 18 inches, is ramose and sheeted all over with very showy, segmented, rosaceously-purple flowers, and is, in all respects, one of the best of our hardy flowering annuals. A permanent variety of it, *Clarkia pulchella flore albo*, has white-coloured flowers.

CLARY.—botanically *Salvia*. Several species of hardy herbaceous plants, of the sage genus. The common species, *Salvia sclarea*, was introduced from Italy in 1562. It is a biennial, of about four feet in height, with large leaves, and carrying light blue flowers from July till September; and it is frequently cultivated, as an aromatic herb, in kitchen gardens. Its flowers are used for making wine; and its leaves are employed for various culinary purposes. It is sown in spring, and transplanted in summer at distances from plant to plant of between 6 and 12 inches.—The Horminum species, *Salvia Horminum*, was introduced from the south of Europe in 1596. It is an annual of 12 or 14 inches in height, and carries a purple-coloured flower in June and July; and is also occasionally cultivated as an aromatic herb. Two varieties of it, the purple-topped and the red-topped, *S. H. violacea* and *S. H. rubra*, are cultivated both for economical purposes and for ornament.—The meadow species, *Salvia pratensis*, is a perennial-rooted and rare weed of the dry pastures of England. Its stem is 3 or 4 feet high; its leaves are dark green; and its flowers are large, violet-coloured, and handsome, and bloom from May till Novem-

ber.—The vervain species, *Salvia verbenacea*, is a perennial-rooted weed of the chalky and gravelly pastures of Britain. Its stem is about two feet high; its leaves are greyish-green; and its flowers are small and bluish-violet-coloured, and bloom from June till October. It has cordial and astringent qualities, whether fresh or dried; and is much esteemed, by many persons, for medicinal purposes and for flavouring wine.—A number of other species of *Salvia* are sometimes popularly called clary. See the articles *SAGE* and *SALVIA*.

CLASSIFICATION. See *BOTANY* and *SOILS*.

CLATTING. The removing of a portion of the wool from the tails and udders of pregnant ewes a little before their lambing. The practice is effected by throwing the ewes, and is very useful, as a preventive of the mischievous cohesion of the wool from the effects of purging.

CLAUSENA. A small genus of evergreen, tropical fruit-trees, of the orange tribe. The five-leaved species, *Clausena pentaphylla*, formerly called *Limonia pentaphylla*, was introduced to our hothouses from India in 1800. It grows in India, to the height of 20 or 25 feet; its flowers are white, and bloom from June till August; and its fruit is smooth, roundish, red, and about the size of a cherry, and is eaten by the common people.

CLAY. Any kind of earthy matter which is characterized by the presence of alumina. See the articles *ALUMINA* and *ARGILLACEOUS EARTH*. Clays, in a geological respect, are of very various age and character, and are found in great abundance, composing strata of more or less importance and distinctiveness, from nearly the lowest fossiliferous beds up to the most recent alluvium. See the article *GEOLOGY*. Even surface clays, or clays lying near the surface, are very diversified as to both their origin and their mineral constitution. Some yellow clay, such as abounds in many parts of Denmark, is supposed to consist of the altered felspar, the unaltered mica, the pulverized quartz, and the recombined magnetic and titanite oxides, of decomposed granite. Most blue clays consist of decomposed syenite and greenstone, and do not contain any mica. Many clays have been formed by the disintegration of porphyry, and are easily distinguishable into thin quartzose, felspathic, and peculiarly aluminous constituents. "The analysis of the porcelain clays," says Liebig, "proves that the felspars from which they were formed have not reached their utmost limit of disintegration, for they still contain potash. The porcelain clays are those which are refractory in the fire, and do not melt when exposed to the strongest heat of our furnaces. The difficult fusibility of the porcelain clays depends upon their proportion of the alkaline bases, potash, soda, lime, magnesia, and protoxide of iron. When we compare the other kinds of clay with the porcelain clays, we find that the infusible clays, or clays poor in potash, are of rare occurrence. The clays diffused through

the most kinds of rocks, those occurring in arable land, and those in the beds of clay interspersed with the layers of brown and mineral coal, contract when exposed to heat, and become vitrified in a strong fire. Loam also melts in a similar manner. When the oxides of iron are not present in the clays, their fusibility is in direct proportion to the amount of their alkaline ingredients. Clays arising from the disintegration of the potash felspars, are free from lime; those formed from Labrador spar—the principal component of basalt and lava—contain lime and soda.

"The limestones containing much clay are proportionally the richest in alkaline ingredients. The marls and stones used for cement belong to this class of minerals. They differ from other limestones by possessing the property, after burning, of hardening, when in contact with water. During the burning of marl and of many other natural cements, the constituents of the clay and lime act chemically upon each other, giving rise to anhydrous apophyllite, or an analogous compound of silicate of potash and silicate of lime, which, being brought in contact with water, forces the latter into chemical combination in a similar manner to burnt gypsum, and crystallizes along with it. When a fragment of chalk is moistened with a solution of silicate of potash, the latter forms a new compound on the surface, and this becomes hard and stony. The lime of the chalk takes the place of potash in the silicate of potash, and a certain quantity of potash is set at liberty in the form of a carbonate.

"The preceding remarks prove very clearly that arable land has had its origin in the chemical and mechanical actions exerted upon rocks and minerals rich in alkalies and alkaline earths, by which means their coherence has been gradually destroyed. It is scarcely necessary to furnish any further proofs that all clays, whether they be pure or mixed with other minerals, so as to form soils, suffer progressive and continued changes. These changes consist in the giving of a soluble form to the alkalies and alkaline bases, by the combined action of water and of carbonic acid. This gives rise to the formation of soluble silicates, or, if these are decomposed by the carbonic acid, to the hydrate of silica, which, being in its peculiar soluble condition, may be taken up by the roots of plants."

A clayey subsoil requires peculiar, operose, and expensive management, but will be discussed in the article on *DRAINING*; and clayey soils, of different characters, require peculiar husbandry and considerable nicety of treatment, but will be discussed in the articles on *SOIL* and *ROTATION*. Some varieties of clay surface are almost totally barren; and others are the most exuberantly fertile within the British dominions. See the articles *CARSE* and *BARREN SOILS*. The worth or worthlessness of clayey land is dependent, in many instances, on the porosity or the retentiveness of the subsoil, but, in more, upon

its own intrinsic composition, and upon the georgic treatment which it has received. Every clay soil which contains too large a proportion of alumina, or which is unduly fine, soft, and unctuous, is over-tenacious, compact, and adhesive, and requires to be improved, both in its mechanical texture, by an intermixture of siliceous sand or gravel, and in its chemical character, by the addition of farm-yard and calcareous manures. Coarse, moorish clay lands, of the class so well known in Scotland under the name of till, contain a comparatively large proportion of the oxides of iron, and are of a hard and obdurate nature, and require a large amount of working, manuring, draining, and exposure, in order to be reclaimed from their stubbornness, and reduced to fertility.

Burnt clay is, in some districts of England, extensively used and highly extolled as a fertilizer of several kinds of soils, and particularly of such as are too retentive, and require to be rendered porous and friable. See the article *ASHES*. The beneficial action of so seemingly incongruous a manure as mere burnt clay or calcined argillaceous earth, is usually ascribed to the insolubility which the clay has acquired from calcination, and to its consequent similarity of mechanical power to that of siliceous sand; but the true cause, according to Liebig, is the following:—"Peroxide of iron and alumina are distinguished from all other metallic oxides by their power of forming solid compounds with ammonia. The precipitates obtained by the addition of ammonia to salts of alumina or iron are true salts, in which the ammonia is contained as a base. Minerals containing alumina or oxide of iron also possess, in an eminent degree, the remarkable property of attracting ammonia from the atmosphere, and of retaining it. Vauquelin, whilst engaged in the trial of a criminal case, discovered that all rust of iron contains a certain quantity of ammonia. Chevalier afterwards found that ammonia is a constituent of all minerals containing iron; that even hematite, a mineral which is not at all porous, contains one per cent. of it. Bouis showed also, that the peculiar odour observed on moistening minerals containing alumina, is partly owing to their exhaling ammonia. Indeed, many kinds of gypsum and some varieties of alumina, pipe-clay for example, emit so much ammonia, when moistened with caustic potash, even after they have been exposed for two days, that reddened litmus paper held over them becomes blue. Soils, therefore, containing oxides of iron and burnt clay must absorb ammonia, an action which is favoured by their porous condition; they further prevent, by their chemical properties, the escape of the ammonia once absorbed. Such soils, in fact, act precisely as a mineral acid would do, if extensively spread over their surface. The ammonia absorbed by the clay or ferruginous oxides is separated by every shower of rain, and conveyed in solution to the soil."

But one large proportion of the calcined or incinerated matter which the English farmers use as manure is in a great degree calcareous; and another large proportion contains a somewhat bulky admixture of vegetable ashes,—the residuum of the combustion of grasses, sedges, rushes, shrubs, and all sorts of rank and weedy vegetation dug up from the borders of fields, the sides of hedges, and the scourings of ditches; and the former of these kinds of burnt matter operates on soil in a manner similar to calcareous marl, while the latter exerts a direct and mighty power of precisely the same nature as the ashes of wood or turf. In all manuring with what is popularly termed burnt clay, close and judicious regard should be had both to the precise nature of the material itself, and to the particular defect or needs of the land to which it is applied. The treating of all sorts of burnt clayey-looking earth or sward as of one nature, and the indiscriminating application of it to all lands of clayey character, without reference to exigency or mode of action, are practices totally unworthy of the enlightenment of the nineteenth century, and exceedingly likely to issue in a greater or less degree of disappointment.

Native, unburnt clay, especially such as is highly aluminous, is the best possible material for improving light, arid, sandy soils, and white, gravelly, hungry, moorish lands. But it requires to be so prepared and applied as to enter into ready and complete incorporation with the soil; for if it lie in lumps and masses, it will speedily be washed into solution with rains, and carried by infiltration to the bottom, there to form a retentive subsoil, and render the land cold, sour, and worse in quality than before. A good method of securing its incorporation, is to lay it on the land, while the latter is in grass, and is about to be broken up for tillage or fallow,—to permit it to lie exposed on the grass, till it becomes dried and pulverized by the action of winds and frosts and general weather,—to divide and scatter it by repeated slight harrowings,—and, after it is thoroughly distributed and well pulverized, to turn it into the soil by an ordinary ploughing. About 50 tons per acre may, on the average, be a proper quantity for deep, fine, alluvial, sandy soil, and probably 150 tons for white, gravelly, moorish land.—*Lyell's Geology*.—*Beaton's New System of Cultivation*.—*Liebig's Chemistry of Agriculture*.—*Sir John Sinclair's General Report of Scotland*.—*Reports to the Board of Agriculture*.—*Journal of the Royal Agricultural Society of England*.—*Rham's Dictionary of the Farm*.—*Bradley's Husbandry*.

CLAYTONIA. A genus of hardy, ornamental, herbaceous plants, of the purslane tribe. The Virginian species, *C. virginica*, was brought to England by a Mr. Clayton, about the middle of last century. Its root is tuberous; its stems are slender, and from 3 to 6 inches high; its leaves are succulent, deep-green, narrow, and about 2

inches long; and its flowers are five-petalled, open, white, and spotted or striped with red, and grow in loose bunches at the top of the stems, and bloom from March till May.—The perfoliate species, *C. perfoliata*, was introduced from North America in 1794. It is a white-flowered annual, of from 6 to 12 inches in height, not unfrequently cultivated in ordinary collections, but more curious than beautiful.—Six other species, three of them tuberous-rooted, and the rest annuals, may occasionally be seen in British gardens.

CLEANING. The removing of every kind of filth and dirtiness from the bodies of farm animals. The cleaning of all kinds of farm stock contributes to both their beauty and their health. If even swine could be cleaned as regularly and thoroughly as horses usually are, they would be more thriving than under their present treatment. Swine, in a few instances, are regularly cleaned by hand; but, in most, are merely provided with one or more rubbing-posts, and with frequent renewals of litter. When cattle have their legs soiled by labour or by walking on foul ground, they should be driven two or three times a-day through a pond; and such of them as are turned into house-shelter, should be well rubbed with dry straw. Picking the feet of horses and cattle from gravel and small stones ought frequently to be practised; and combing and brushing, at the first meal of the morning or at the last in the evening, or at other times when the hair and the skin are dry, will well repay, in the animal's health and vigour, all the labour which they involve. The importance of keeping horses constantly and perfectly clean is generally and somewhat well understood; but the importance of cleaning the other animals of the farm requires to be considered and enforced. See the article **GROOM**.

CLEANSING. See **ABORTION** and **PARTURITION**.

CLEARING. A heap of corn in the barn large enough to be winnowed; also, the removal from land of large stones, stumps of trees, and other obstacles to the operation of the plough; also, the conversion of a portion of forest ground into arable land.

CLEARING-NUT. See **STRYCHNOS**.

CLEAR-UNDERWING,—scientifically *Ageria asiliformis*. A boring and mischievous insect, of the coleopterous order. Its caterpillar penetrates wounded or unbarked portions of the trunks of poplars, gnaws a cell or chamber in the interior, and eats the duramen thence toward the exterior till only a sufficient thickness is left to protect it from the weather. The transformation into the pupa state occurs in this retreat; and the transformation from that state to the state of the imago, is accompanied by the bursting of the thin partition. The chrysalis, when about to be transformed, first forcibly pushes its head against the partition, and then, by means of the resisting power of the minute teeth or serrated pro-

cesses with which each ring or segment of its body is provided, extends itself till it breaks the barrier; and, when the head is protruded, the chrysalis case splits, and the perfect insect escapes. The attacks of the caterpillar upon poplars, and the consequent injuries inflicted on the tree, can be diminished or palliated only by destroying as many as possible of the perfect insects.

CLEAVERS. See **HARIFF**.

CLEDGY LAND. Stiff, hard, stubborn, tenacious soil.

CLEG, or GLEG. Two species of dipterous insects, of the tribe Tabanidæ. The cleg, horse-cleg, or common horse-fly, is scientifically called *Hematopota pluvialis*; thus bearing a generic name which signifies 'drinker of blood,' and a specific one which signifies 'showery,' and alludes to its excessive blood-thirstiness during the prevalence of warm showery weather. It is at once the most numerous, the most untiring, and the most tormenting of the family of horse-flies. Its speckled wings, its green eyes with transverse, undulating, purple-brown bands, its dark brown abdomen, with the hinder margins of the segments, a dorsal line, and a series of faint spots on each side, of a light grey colour, are characters by which it is readily distinguished. The male is seldom seen, appears to exist in very small numbers compared to the female, has its oral organs much less developed than those of the female, and seems to be innoxious in habit, and to subsist entirely on the juicy secretions of flowers.

The cattle cleg is scientifically called *Tabanus bovidus*; and, though not very abundant in England or in the Scottish Lowlands, is an excessive pest of cattle in the Scottish Highlands. It is robust, and about an inch in length; and is one of the largest and most conspicuous of British diptera. It has similar habits to those of the horse-cleg, the females feeding upon blood, and the males upon floral-secretions. Its larva is long and cylindrical, and narrows at the head into an elongated cone; its body comprises twelve rings or segments, the anal one of which appears like a small tubercle; its head, besides having two short antennæ, is provided with two small scaly hooks, which it employs in locomotion, and in perforating the soil; and most of its segments are encircled with a dark-coloured band, which is beset with numerous retractile tubercles for performing the chief offices of locomotion. The pupa is nearly cylindrical, and of a greyish brown colour; its segments are fringed on the hinder margins with grey hairs; and its anal segment, though small in size, is armed with six sharp scaly points, which enable the pupa to push its head above the surface of the soil. See the articles **HORSE-FLIES** and **BOTS**.

CLEMATIS. An important genus of beautiful flowering-plants, of the ranunculus tribe. They are characterized by their opposite leaves, their valvate-coloured calyx, and the long feathery

styles of their ripe carpels. One species grows wild in England; about 45 species have been introduced from foreign countries; and about 40 other species are known to botanists. Seven of the introduced species, *C. erecta*, *angustifolia*, *lineariloba*, *diversifolia*, *cylindrica*, *integrifolia*, and *ochroleuca*, are hardy, perennial-rooted herbs; and all the others are ligneous twiners,—about one-half deciduous, and the remainder evergreen,—about one-fourth more or less tender, and the remainder quite hardy. The climbers, as a group, are eminently beautiful, in at once their foliage, their flowers, and their carpels; but even the hardy species are impatient of damp in winter, and in consequence require more nicety of treatment than most other hardy climbers. We can afford to notice only three or four species as specimens of the whole genus.

The common hedge species, *C. vitalba*, popularly called traveller's joy, white vine, bind-with, and old man's beard, grows naturally in the hedges of England, and of most of the northern parts of continental Europe. It is an object of great natural beauty, loading the hedges first with its profuse clusters of white blossoms, and next with its heaps of feather-tailed, silky tufts; presenting, at various seasons, but particularly in winter, a peculiarly interesting appearance; and acquiring its name of traveller's joy, from its power of charming and refreshing the weary traveller. Its stems usually attain a height of about 20 feet, but sometimes climb up trees to nearly treble that height; its ramifications are so numerous and subdivisive as to overtop and cover hedges, shrubs, and almost everything on which they climb; its branches are so thick and tough as to be often used by wood-cutters for bundling faggots; its leaves are pinnated, bluish-green, and moderately large, and have a tendency to cling and twine in the manner of claspers; and its flowers are produced in clusters over all the plant, and appear from June till September. Some varieties of this species have the edges of their folioles indented, and others have these edges entire. A plant of *Clematis vitalba* at Shenley rectory in Herts, has two stems, each as thick as the calf of a man's leg, and runs up a fir-tree to the height of about 50 or 60 feet.—The Viorna species, *C. viorna*, grows wild in North America, and was introduced to Britain in 1730. It was generally confounded by the older botanists with *C. vitalba*; and it continues to share with it the popular name of traveller's joy; but it seldom grows to quite two-thirds of the height of that species.

The virgin's-bower or vine-bower species, *C. viticella*, is a hardy deciduous climber, introduced to Britain from Spain toward the close of the 16th century. It is a sort of type of a division of the genus, comprising five or six of the species cultivated in Britain; and it often gives its popular name of virgin's-bower to the whole genus. Four varieties of it have long been in

cultivation,—the double purple, the single purple, the blue, and the red. The double purple, when properly supported, grows to the height of 20 or 30 feet, and is admirably adapted to cover walls, hedges, and arbours. It becomes so leafy as to afford not only shade from sunshine, but protection from a moderate shower; and, when fully rooted, it makes a growth of from 10 to 16 feet in one year. Its young branches are of a fine green colour, and nearly square; its older branches are of a dusky or dark brown colour, and angular or channelled; its leaves grow from the joints of the branches, and are both pinnate and bipinnate; its folioles are oval and entire; and its flowers are double, and purple, and bloom from June till September. The single purple variety is rather a stronger shooter than the double purple, and climbs to a greater height. The blue differs from the single purple only in the colour of its flowers. The red is much lower in growth, and has weaker, shorter, and more delicate shoots.

The flame species, *C. flammula*, was introduced from the south of France, toward the close of the 16th century. It is a hardy deciduous climber; and is sometimes regarded as the type of the largest division of the genus, comprising rather more than one half of all its species. It climbs, with due support, to the height of about 20 feet; its stems are numerous and slender; its lower leaves are pinnate, and have jagged edges; its upper leaves are single, lanceolate, and entire; and its flowers are white and extremely elegant, and bloom from July till October. Four very distinct varieties of this species are in cultivation,—the round-leaved, or fragrant, *C. f. rotundifolia*,—the maritime, *C. f. maritima*, loving saline air, and blooming somewhat earlier than the other varieties,—the tufted, *C. f. cæspitosa*,—and the reddish, *C. f. rubella*, with reddish-coloured flowers.

The tendrilled species, *C. cirrheosa*, was introduced from Spain in 1596. It is a hardy evergreen climber, of very different habits of flowering from most of the other species. Its stems usually attain a height of from 6 to 12 feet, but are exceedingly slender, and rise almost wholly by the power of their claspers; its branches are very numerous and feeble, and so intertwine with one another as to form a dense, thickety growth; some of its leaves are simple and entire, some two-lobed, and some three-lobed, and all have a beautifully green colour; the most perfect of its leaf-lobes are indented and nearly lanceolate; and its flowers are large, have a whitish-green colour, are produced from the sides of the branches, bloom in the latter part of winter and early part of spring, and combine with the shining green foliage to render the plant a valuable ornament of the cold and cheerless season of March winds. Three other hardy evergreen species cultivated in Britain, the Balearic, the pedicellate, and the half-three-lobed, have a considerable resemblance to the tendrilled.

The violet-flowered species, *C. cœrulea*, was introduced from Japan in 1836. It is a hardy deciduous climber, and a most charming addition to the climbers cultivated in Britain. It has a most graceful habit of growth; and its large violet flowers, with deep purple stamens, are more beautiful than those of any of the previously introduced species. Its stem is slender, hairy, and usually about 12 feet high; its leaves are alternate, bright green above, very shining below, standing on long footstalks, and ternately or pinnately divided; its folioles are ovate or ovate-lanceolate, pointed, entire yet marginately wavy, and stand on long partial footstalks; and its flowers are of a most delicate blue colour, and nearly seven inches in diameter, and appear in April.

CLEOME. A genus of ornamental plants of the caper-tree tribe. A number of species formerly included in it are now assigned to six other genera; but upwards of twenty species still belonging to it are cultivated in British gardens, and between 30 and 40 other species have been scientifically described. Most of the species have sometimes been called bastard-mustard, and may be regarded as, in a loose and general manner, described by that name. One or two which grow wild in India, are there called dog-mustards, and esteemed somewhat anthelmintic and carminative. The majority of the species in Britain are annuals; and a few of these, particularly *C. pentaphylla*, *C. rosea*, and *C. spinosa*, have a place in most tolerably good collections. Three species, *C. arborea*, *C. dendroides*, and *C. gigantea*, are tender evergreen shrubs, of from 5 to 9 feet in height.

CLERCK'S MOTH,—scientifically *Heribea clerckella*. A lepidopterous insect, of the moth tribe. Its body is scarcely more than one-twelfth of an inch in length; but its wings are a quarter of an inch long,—the upper pair silvery, golden brown at the tip, somewhat streaked, and with a deep black, round eyelet at the extremities. It is an exceedingly beautiful little insect, and so very active that a living specimen of it cannot, without great difficulty, be obtained; but it is an old and increasing pest in gardens and orchards, and inflicts material injury upon pear-trees. Its eggs seem to be deposited on the under surfaces of the leaves; and the caterpillars seem to penetrate the epidermis, and feed upon the parenchyma. Brown circular spots of about half an inch in diameter, and similar to such as might be occasioned by excess of heat, appear upon the leaves, and enclose the caterpillars; and whenever these are numerous, the fruit is both small and ill-flavoured.

CLERODENDRON. A genus of very beautiful, evergreen, tropical shrubs of the verbena tribe. About forty species have been introduced to Britain, all since 1784, and principally from India, China, and Nepaul; and two or three other species have been described. One of the

introduced species is a twiner; and the others are erect shrubs of from 3 to 10 feet in height. All are handsome and some are superb; and if brought into flower in the stove, and gradually attuned to the greenhouse, they will bloom during three months in the latter, at a season when little else of prime character can be had to decorate it. A mistake prevails, and ought to be dissipated, that clerodendrons will show good bloom only in heat so intense as to be intolerable by an European. We shall illustrate the genus by a brief notice of three of its species.

The unfortunate species, *C. infortunatum*, was introduced since 1840 from Ceylon. Its stem is quadrangular, and about six feet high; its leaves are heart-shaped and large; its flowers have a deep crimson colour,—are formed of five unequally spreading portions, similar to those of the common garden azaleas, with long protruding coloured stamens or thread-like appendages,—and are produced, in spreading panicles, on the summits of the shoots.—The glandular-bracted species, *C. glandulosum*, is a plant of exceedingly noble and magnificent appearance. Its leaves are large, and oval, and seem as if bitten off at the base; and its flowers have a scarlet colour, grow in heads, and are surrounded by long, narrow, permanent bracts.—The deceitful species, *C. fallax*, was brought from China in 1790. Its leaves are large, roundish, heart-shaped, and toothed; its flowers have a scarlet colour, and are intermediate in size between those of the unfortunate and the glandular-bracted species; and its calyxes, instead of being divided through half their length into five segments, are provided with five short teeth.—Many of the other species have white and whitish-red flowers. The phlomis-like species is used medicinally in India as an alterative. Glory-tree has been proposed as the popular name of the clerodendrons; but it has not yet become well established.

CLETCH. A brood of chickens, goslings, or other birds.

CLETHRA. A genus of white-flowered shrubs and small trees, of the heath tribe. The alder-leaved species, or American alder, *C. alnifolia*, was brought from North America in 1731. It is a hardy deciduous shrub, of 4 or 5 feet high with us, and 8 or 10 feet in its native country. Its branches are not numerous; its leaves are spear-shaped, serrated, about three inches long and an inch and a half broad; and its flowers are fragrant, grow in long spikes at the ends of the branches, and bloom from July till October.—Six other deciduous species, and two evergreen species, have been introduced; but the evergreens are tall and tender.

CLIANTHUS. See **GLORY-PEA**.

CLICK-BEETLE. See **ELATER** and **WIRE-WORM**.

CLICKING, or OVERREACH. The hitting of the toe of the hind-foot against the shoe of the fore-foot, in the locomotion of the horse. It

makes a disagreeable sound, and is not wholly free from danger. If the horse be young, the fault may be mended, but, if otherwise, it can at best be but slightly alleviated.

CLIDEMIA. A genus of beautiful, evergreen, tropical shrubs, of the *melastoma* tribe. Twelve species, all natives of the tropical parts of America, have been introduced to our hothouses; they vary in height from a foot to two yards; most of them are white-flowered; and about one half were formerly included in the genus *melastoma*, and may be regarded as sharing with it the popular name of American gooseberry-tree.

CLIFFORTIA. A genus of ornamental, evergreen, Cape-of-Good-Hope, greenish-flowered shrubs, of the *rosaceous* order. The stem of the species longest and best known in Britain, is weak and about four feet high; its branches are numerous, spreading, rambling, and so feeble as to require some support; its leaves are heart-shaped at the base, broad and sharply-indented at the end, stiff, greyish, sessile, and alternate; its flower-buds rise singly from the bosom of the leaves, and have a shape, a size, and an appearance similar to those of the caper plant; and its flowers have a yellowish-green colour, and appear from May till the end of August. About 24 other species are known to botanists; and two-thirds of them may occasionally be seen in British gardens.

CLIFTONIA. See *BUCKWHEAT-TREE*.

CLIMATE. We have learned from a more accurate acquaintance with different countries, that heat or cold depends not merely on geographical latitude, but that local causes also produce great variations from the general rule, by which a region lying near the equator should always be warmer than one remote from it. By the word *climate*, therefore, we understand the character of the weather peculiar to every country, as respects heat and cold, humidity and dryness, fertility, and the alternation of the seasons. The nature of a climate is different according to the different causes which affect it, and the observations hitherto made have led, as yet, to no definite result. In general, however, geographical latitude is the principal circumstance to be taken into view in considering the climate of a country. The highest degree of heat is found under the equator, and the lowest, or the greatest degree of cold, under the poles. The temperature of the intermediate regions is various, according to their position and local circumstances. Under the line, the heat is not uniform. In the sandy deserts of Africa, particularly on the western coast, also in Arabia and India, it is excessive. In the mountainous regions of South America, on the contrary, it is very moderate. The greatest heat in Africa is estimated at 70° of Reaumur, or 189½° of Fahrenheit. The greatest degree of cold at the poles cannot be determined, because no one has ever penetrated to them. The greatest altitude of the sun at noon, and the time of its continuance above the horizon, de-

pends altogether on the latitude. Without regard to local circumstances, a country is warmer in proportion as the sun's altitude is greater and the day longer. The elevation of any region above the surface of the sea has likewise an important influence on the climate. See article *ALTITUDE*. But the nature of the surface is not to be disregarded. The heat increases as the soil becomes cultivated. Thus, for the last thousand years, Germany has been growing gradually warmer by the destruction of forests, the draining of lakes, and the drying up of bogs and marshes. A similar consequence of cultivation seems to be apparent in the cultivated parts of North America, particularly in the Atlantic states. The mass of minerals, which composes the highest layer of a country, has, without doubt, an influence on its temperature. Barren sands admit of a much more intense heat than loam. Meadow lands are not so warm in summer as the bare ground. The winds, to which a country is most exposed by its situation, have a great influence on the climate. If north and east winds blow frequently in any region, it will be colder, the latitude being the same, than another, which is often swept by milder breezes from the south and west. The influence of the wind on the temperature of a country is very apparent in regions on the sea-coast. The difference in the extremes of temperature is least within the tropics. The heat, which would be intolerable when the sun is in the zenith, is mitigated by the rainy season, which then commences. When the sun returns to the opposite half of the torrid zone, so that its rays become less vertical, the weather is delightful. Lima and Quito, in Peru, have the finest climate of any part of the earth. The variations in temperature are greater in the temperate zones, and increase as you approach the polar circles. The heat of the higher latitudes, especially about 59° and 60°, amounts, in July, to 75° or 80° of Fahrenheit, and is greater than that of countries 10° nearer the equator. In Greenland the heat in summer is so great that it melts the pitch on the vessels. At Tornea, in Lapland, where the sun's rays fall as obliquely at the summer solstice, as they do in Germany at the equinox, the heat is sometimes equal to that of the torrid zone, because the sun is almost always above the horizon. Under the poles, the climate is, perhaps, the most uniform. A greater degree of cold than any we are accustomed to, seems to reign there perpetually. Even in midsummer, when the sun does not go down for a long time, (at the poles not for six months,) the ice never thaws. The immense masses of it, which surround the poles, feel no sensible effect from the oblique and feeble beams of the sun, and seem to increase in magnitude every year. This is very remarkable; for there is the most undoubted evidence that these now deserted countries were, in former ages, inhabited. But, within a few years, large portions of this continent (if we may

so call it) of ice have separated, and floated down to southern seas. This led the English government to adopt the project of penetrating to the north pole.

From the general division of America into lofty mountainous *plateaus* and very low plains, there results a contrast between two climates, which, although of an extremely different nature, are in almost immediate proximity. Peru, the valley of Quito, and the city of Mexico, though situated between the tropics, owe to their elevation the general temperature of spring. They behold the *paramos*, or mountain ridges, covered with snow, which continues upon some of the summits almost the whole year, while, at the distance of a few leagues, an intense and often sickly degree of heat suffocates the inhabitants of the ports of Vera Cruz and of Guayaquil. These two climates produce each a different system of vegetation. The flora of the torrid zone forms a border to the fields and groves of Europe. Such a remarkable proximity as this cannot fail of frequently occasioning sudden changes, by the displacement of these two masses of air, so differently constituted—a general inconvenience, experienced over the whole of America. Everywhere, however, this continent is subject to a lower degree of heat than the same latitudes in the eastern portion of the earth. Its elevation alone explains this fact, as far as regards the mountainous region; but why, it may be asked, is the same thing true of the low tracts of the country? To this the great observer, Alexander Humboldt, in his '*Tableaux de la Nature*,' makes the following reply:—"The comparative narrowness of this continent; its elongation towards the icy poles; the ocean, whose unbroken surface is swept by the trade winds; the currents of extremely cold water which flow from the straits of Magellan to Peru; the numerous chains of mountains, abounding in the sources of rivers, and whose summits, covered with snow, rise far above the region of the clouds; the great number of immense rivers, that, after innumerable curves, always tend to the most distant shores; deserts, but not of sand, and consequently less susceptible of being impregnated with heat; impenetrable forests, that spread over the plains of the equator, abounding in rivers, and which, in those parts of the country that are the farthest distant from mountains and from the ocean, give rise to enormous masses of water, which are either attracted by them, or are formed during the act of vegetation,—all these causes produce, in the lower parts of America, a climate which, from its coolness and humidity, is singularly contrasted with that of Africa. To these causes alone must we ascribe that abundant vegetation, so vigorous and so rich in juices, and that thick and umbrageous foliage, which constitute the characteristic features of the new continent." To these remarks Malte-Brun adds:—"Assuming this explanation as sufficient for South America and Mexico, we

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shall add, with regard to North America, that it scarcely extends any distance into the torrid zone, but, on the contrary, stretches, in all probability, very far into the frigid zone; and, unless the revived hope of a north-west passage be confirmed, may, perhaps, reach and surround the pole itself. Accordingly, the column of frozen air attached to this continent is nowhere counterbalanced by a column of equatorial air. From this results an extension of the polar climate to the very confines of the tropics; and hence winter and summer struggle for the ascendancy, and the seasons change with astonishing rapidity. From all this, however, New Albion and New California are happily exempt; for, being placed beyond the reach of freezing winds, they enjoy a temperature analogous to their latitude."

Climate acts in a powerful manner upon the physical constitution of animals, and demands at least an equal share of attention. By the terms difference of climate, we commonly include, in a general manner, all those conditions of the atmosphere which occasion a greater degree of heat and moisture to prevail in one place rather than in another; and it may be easily imagined, that if the nature of the media, in which animals habitually reside, exercises an important influence over them, they will also be influenced by the temperature and moisture of the climate. They are more susceptible than man to the immediate influence of changes of temperature, from being continually exposed to the inclemency of the air, and seem acutely sensible of great and sudden changes of the atmosphere. We even observe them foretelling and announcing an approaching change of the weather by various premonitory signs. As the climate may be either hot or cold, dry or moist, each of these conditions induces very different results in respect to their reproduction, constitution, amelioration, and, in general, all the vital functions of the domestic animals.

Heat being one of the most powerful stimuli of the vital reproductive powers, seems conducive both to fertility and growth, especially when accompanied by moisture; cold, on the contrary, is generally injurious. We remark that Nature develops all her treasures of fertility in the ardent climates of the south, while the icy regions of the north are generally less peopled, more uniform and inanimate in their general aspect. Melancholy solitudes replace, in these desolate regions, the most active and well-marked scenes of animation, which however are less permanent, and pass more rapidly away. It thus appears, that the active force of heat, which bears an intimate relation to that of light, exalts the intensity of all the faculties and properties, and gives them the fullest energy which they are capable of acquiring. By the same law which assigns to the plants of the south more exquisite flavours, aromata, essential oils, perfumes, and colours, than to those of the north, we find the

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animals of warm countries also exhibiting a greater richness and variety in their hues, more vivacity and energy of character, more activity and strength in all their parts. Everything proclaims in Nature the beneficial influence of warmth over reproduction, as well as upon the form and qualities of its productions.

It appears, however, that heat, while it augments the energy of the vital powers, contributes a more diminutive growth to the organs of the different functions, probably because the moisture which contributes much to this development is less abundant, and because the solids of the animal body bear a greater ratio to the fluids, which are more or less dissipated by heat. Climates of dry and warm character render their fibres rigid, slim, moveable, and irritable, and they become deprived of that moisture, which had lessened their sensibility by softening them. Thus, we constantly observe that horses, bulls, sheep, goats, dogs, and other domestic animals, are proportionably smaller, but more vivid, ardent, and active in warm countries, than animals of the same species in colder regions, provided always that the cold be not too intense. An excess of cold is, however, still more injurious to growth. The largest races of cattle are found in temperate climates, which are moderately cold and moist. A moderate degree of cold, by giving density and elasticity to the animal fibre, when influenced by an adequate supply of moisture, becomes at once favourable to the growth and multiplication of the species. See the articles ALTITUDE, ATMOSPHERE, DRAINING, HEAT, and ACCLIMATATION OF ANIMALS.

CLIMBERS, or CLIMBING-PLANTS. Plants which have not sufficient strength in themselves to assume and maintain an erect position, and which attach their stems and branches, by means of lateral roots, imperfect petioles, and other peculiar organs, to trees, walls, or other steady objects for support. Familiar examples of these plants are the ivy, the vine, and the clematis. A common and very pleasing method of cultivating ornamental climbers, is to train them upon trellises. See the article TRELLIS.

CLINOPODIUM. See BASIL (WILD).

CLINTONIA. Two very beautiful and recently discovered hardy annual plants, of the lobelia tribe. They differ from true lobelias, principally in the circumstance of their long filiform ovary bursting longitudinally; and they have been made a new genus, with the specific names *elegans* and *pulchella*. They were introduced to Britain, the former from Columbia in 1827, and the latter from California in 1832; and they have already become well diffused and great favourites. Both have a height of about 6 or 8 inches; and the *elegans* has blue flowers,—the *pulchella*, a combination of blue, white, and yellow. But a variety of the latter is characteristically white-flowered, and has obtained the name of *Clintonia pulchella alba*.

CLIPPING. See SHEEP-SHEARING.

CLIPS. Portions of the upper edge of a horse-shoe, so beaten out and turned up as to lay hold of the lower part of the crust, and strengthen the attachment of the shoe to the foot. They relieve the crust from injurious pressure upon the nail, and, in certain cases, prevent the shoe from being torn off.

CLITORIA. A genus of tender, ornamental, twining plants, of the lotus division of the leguminous family. The winged-leaved species, *C. ternatea*, was introduced to Britain from India in 1739. Its stems are herbaceous and twining like those of the kidney-bean, and usually rise to the height of 4 or 5 feet; its leaves are alternate, beautifully green, and consist each of three or four pairs of folioles and a terminating odd one; its flowers are papilionaceous, broad, open, very large, and so formed that the bottom part seems as if growing to the top; and its pods are long and slender, and contain kidney-shaped seeds. The flowers of one variety have a deep blue colour, and those of another are white; and so powerfully coloured are the former that, after being dried and kept for years, they will convey to paper a stain almost as deep as indigo. The roots of this species are used in India as an emetic, and the seeds as an anthelmintic and a gentle aperient.—The bright scarlet species, *Clitoria fulgens*, is a native of rocky places in the Organ mountains of Brazil; and, as grown in Britain, it requires a warm greenhouse, and seems adapted to trellis training in a pot. Its flowers have a glowing scarlet colour, are produced in axillary clusters, and appear in June.—About a dozen other species have been introduced, and several more are known.

CLOCKS. A very general provincial name for beetles. See BEETLES.

CLOD. A lump of any kind of soil.

CLOD-CRUSHER. See ROLLER.

CLOGS. Billets of wood; also, wooden-soled shoes.

CLOTHES-MOTH,—scientifically *Tinea tapezella*. A well-known, mischievous insect, of the lepidopterous order. Its wings measure 8 or 9 lines from tip to tip; the upper pair are, from the base to the middle, very dark brown or nearly black,—and, beyond the middle, white but indistinctly marked with brown spots; its lower wings are ash-grey, with long and silky fringe; its body and legs are black; its head is white; and its antennæ are slender, and taper in the manner of bristles. The caterpillar is soft and white; its head is brown; its body is beset with a few scattered hairs; and its legs are very short and wart-like. The eggs of the moth are usually deposited on woollen cloth; and the caterpillars obtain thence both food and materials for a sort of mantle or tubular covering to their body. Each caterpillar, almost immediately after issuing from the egg, begins to move forward upon the cloth, in a direct or tortuous line, and to shear, with its

sharp, scissors-like mandibles, all the filaments of wool which occur on its path, devouring the shorter and finer ones as food, and weaving the longer and coarser ones, along with a silky matter of its own spinning, into its mantle or dwelling. Many of the caterpillars also, as if to ascertain which side of the cloth is most suitable for their purpose, penetrate through the cloth, and, in consequence, not only shear but riddle it. All the portions of cloth actually shorn or pierced by the caterpillars are completely destroyed,—and even adjacent portions are frequently rendered useless. See the article *MOTH*.

CLOUD. The clouds are aqueous vapours, which hover at a considerable height above the surface of the earth. They differ from fogs only by their height and less degree of transparency. The cause of the latter circumstance is the thinness of the atmosphere in its higher regions, where the particles of vapour become condensed. The varieties of clouds are numerous. Some cast a shade which covers the sky, and, at times, produces a considerable darkness; others resemble a light veil, and permit the rays of the sun and moon to pass through them. Clouds originate like fogs. The watery evaporations which rise from seas, lakes, ponds, rivers, and, in fact, from the whole surface of the earth, ascend, on account of their elasticity and lightness, in the atmosphere, until the air becomes so cold and thin that they can rise no higher, but are condensed. Philosophers, however, are of very different opinions respecting the way in which the condensation and the whole formation of the clouds proceed. De Luc, whose theory is considered the most probable, believes that the water, after its ascent in the form of vapours, and before it takes the shape of clouds, exists in a gaseous state, not affecting the hygrometer, which is the reason why the air, in the higher regions, is always dry. He explains the clouds to be collections of small vesicles, in the transformation of which from the gaseous state, he believes that caloric operates, in part at least, because, according to his opinion, clouds communicate a degree of heat to the body which they render damp. According to Hube, clouds are collections of precipitated bubbles, and differ by their negative electricity from fogs, the electricity of which is generally positive. If clouds and fogs lose their electricity, rains is produced. These explanations are, however, by no means perfectly satisfactory.

The change of winds contributes essentially to the formation of clouds and fogs. In countries where this change is small and infrequent, as between the tropics, these phenomena of humidity in the atmosphere must be comparatively rare, but, when they happen, the more violent, because a great quantity of vapour has had time to collect. The distance of the clouds from the surface of the earth is very different. Thin and light clouds are higher than the highest mountains; thick and heavy clouds, on the con-

trary, touch low mountains, steeples, and even trees. The average height of the clouds is calculated to be two miles and a half. Their size is likewise very different. Some have been found occupying an extent of 20 square miles, and their thickness, in some cases, has been ascertained, by travellers, who have ascended mountains, to be a thousand feet: others are very thin, and of small dimensions.

The natural history of clouds, not as respects their chemical structure, but their forms, their application to meteorology, and a knowledge of the weather, has been well treated by Lucas Howard, in his *Essay on Clouds*. He distributes clouds into three essentially different formations. These formations are—1. *cirrus*, consisting of fibres which diverge in all directions; 2. *cumulus*, convex and conical aggregates, which increase from a horizontal basis upwards; 3. *stratus*, layers vastly extended, connected and horizontal. The clouds are generally assigned to three atmospheric regions, the upper, the middle, and the lower one, to which a fourth, the lowest, may be added. In the upper region, the atmosphere is in such a state, that it can receive and sustain aqueous matter dissolved into its integrant parts. This state of the atmosphere corresponds to the highest state of the barometer. To this region belongs the *cirrus*, which has the least density, but the greatest height, and variety of shape and direction. It is the first indication of serene and settled weather, and first shows itself in a few fibres, spreading through the atmosphere. These fibres by degrees increase in length, and new fibres attach themselves to the sides. The duration of the *cirrus* is uncertain, from a few minutes to several hours. It lasts longer, if it appears alone, and at a great height; a shorter time, if it forms in the neighbourhood of other clouds. The middle region is the seat of *cumulus*, which is generally the most condensed, and moves with the stream of air nearest to the earth. This region can receive much humidity, but not in perfect solution. The humidity becomes collected, and shows itself in masses rising conically, and resting on the third region. The appearance, increase, and disappearance of the *cumulus*, in fine weather, are often periodical, and correspondent to the degree of heat. Generally, it forms a few hours after sunrise, attains its highest degree in the hottest hours of the afternoon, and decreases and vanishes at sunset. Great masses of *cumulus*, during high winds, in the quarter of the heavens towards which the wind blows, indicate approaching calm and rain. If the *cumulus* does not disappear, but rises, a thunder-storm is to be expected during the night. If the upper region, with its drying power, predominates, the upper parts of the *cumulus* become *cirrus*. But, if the lower region predominates (into which the densest vapours are attracted and dissolved into drops), the basis of the *cumulus* sinks, and the cloud becomes *stratus*, which is of moderate den-

sity, and its lower surface rests generally upon the earth or the water. This is the proper evening cloud, and appears first toward sunset. To this belong also those creeping fogs, which, in calm evenings, ascend from the valleys, and extend themselves in undulating masses. The *stratus* remains quiet, and accumulates layers, till it last it falls as rain. This phenomenon—the dissolution of clouds into rain—is called *nimbus*. Howard further makes subdivisions, as *cirro-cumulus*, *cirro-stratus*, &c. Also the real *stratus*, the horizontal layer of clouds, sometimes rises higher than at other times, which depends on the season, the polar height of the place, or the heights of mountains: the *cumulus* is also sometimes higher and sometimes lower. On the whole, however, the different kinds remain one above another.

CLOUDBERRY,—botanically *Rubus Chamæ-morus*. An indigenous, perennial-rooted, fruiting herb, of the bramble and raspberry genus. Its stem is from 3 to 8 inches high, and is usually garnished with two lobated leaves, standing at a distance from each other; its flower is solitary and white, and appears in May and June; and its fruit is a small, black berry, somewhat similar to the dewberry, and one of the most delicious wild productions of our country. It occurs, in considerable plenty, on the boggy parts of the lofty mountainous regions of the north of England and of the Scottish Highlands; and it abounds on the alpine boggy grounds of Norway and other portions of northern continental Europe; but it has not yet, to any considerable extent at least, been successfully cultivated in gardens or town-parks for the supply of the city market. Its berries have a peculiarly pleasant flavour, and are both nutritious and medicinal. They are consumed in large quantities, as food, as raw condiment, as confection, as dessert, and in other ways, in both the towns and the rural districts of Norway and Sweden; and they are believed to be grateful to the stomach, cooling to the blood, and sanative of bilious complaints. One cannot but wonder that the cloudberry has not become, in at least the cooler parts of Great Britain, a subject of extensive cultivation.

CLOUTED CREAM. A butyraceous preparation in great vogue in the West of England. It is practically a thinnish or weakish butter, but is prepared by a very different process from churning. "The milk is suffered to stand in a bell-metal vessel 24 hours; it is then placed over a small wood fire, so that the heat shall be very gradually communicated to it. After it has been over the fire about an hour and a half, and is approaching to the state of *simmering*, the vessel is struck every now and then with the knuckles, or is very carefully watched. As soon as it ceases to ring, or the first bubble appears, a slight agitation or simmering, previous to boiling, has commenced; and the secret of the preparation is, that this simmering shall not proceed

to boiling. The milk is immediately removed from the fire, and set by for 24 hours more. At the end of this time, all the cream will have arisen, and be thick enough to cut with a knife; it is then carefully skimmed off." [Knowledge Society's Treatise on Cattle.] This preparation is obtained from milk in about 20 per cent. greater abundance than butter; and in several parts of the West of England, particularly in Devonshire, it is preferred to butter for both its taste and its flavour. The residuum of the milk, however, is so poor as to be fit only for the use of pigs.

CLOVE. See CARNATION and CLOVE-TREE.

CLOVER. The agricultural species of the trefoil genus,—herbaceous and forage plants, of the lotus division of papilionaceous legumes. Nearly twenty species of trefoils are now enumerated in agricultural works as clovers; and though some of these are comparatively obscure and unimportant, others are exceedingly prominent, very valuable, and considerably diversified. Even others, and probably not a few, of the 150 species of trefoils which have been described by botanists may eventually be found well worthy of the attention of the farmer; yet only such as have already been either adopted or favourably tried, shall here be treated as clovers. All have leaves composed of three leaflets, flowers arranged in dense oblong or globular heads, petals remaining attached when withered, and pods, for the most part, shorter than the calyxes.

The common red species, *Trifolium pratense*, is by far the most prominent, and exists in a considerable number of distinct and well-marked varieties. It is both indigenous and exotic,—both perennial and biennial; and varieties of it which are perennial become biennial by long cultivation,—varieties which are biennial can be prolonged through three or more years by being prevented from running to seed,—and some varieties which have for a time been exuberant upon any locality, sometimes become suddenly shy, sickly, refractory, or otherwise unproductive. The stems of all the varieties are upright, branching, and, on the average, about two feet high; the leaflets are oval or inversely heart-shaped; the stipules are ovate and bristle-pointed; the flowers grow in dense globular or slightly elongated heads; and the teeth of the calyxes are bristly-like, and the lower one is longer than the others. The colour of the flowers, though pre-vaillingly reddish purple, is of various shades in the several varieties, and sometimes is even white.

The native, wild variety of red clover grows naturally in old pastures, heathy moors, neglected meadows, and way-sides; and has a general character of such obvious distinctiveness from the cultivated varieties as to have been sometimes pronounced a different species. Its stems, its leaves, and its flowers are darker in colour than those of the cultivated red clover; its leaflets are narrower; its roots are more fibrous; and

its stems and its leaves have a greater degree of downiness or pubescence. Several subvarieties of it are observable,—differing from one another both in minute organic characters and in habit of growth; but all possess its general characters, and exhibit its marks of broad distinction from the cultivated varieties. Every subvariety of native red clover, so far as known, is strictly perennial.

The common cultivated perennial variety of red clover lives through a comparatively short duration, is rather liable to acquire a biennial habit, and differs from the thoroughly biennial sorts principally in having somewhat more pubescence on its leaves, and in its being a few days later in coming into bloom.—The Duke of Norfolk's perennial red clover blooms a week earlier, and has more fibrous roots, and darker-coloured stems, leaves, and flowers, than the common variety; and it lives through a longer period of duration, so as to be more truly entitled to the designation of perennial.—The Argo-vie perennial red clover is more dwarfish and spreading, and has lighter-coloured leaves and flowers, than the two preceding; and most of its leaflets are blotched, near their base, with lightish-coloured spots. It is extensively cultivated, as a perennial clover, in France; and was introduced thence from Switzerland.—The German perennial red clover is very similar to the Argo-vie variety, but flowers a few days sooner, and is rather more productive.

Biennial red clovers comprise very numerous and constantly shifting subvarieties. They are characterized, as a class, by a strictly biennial habit, and by having more fusiform roots and less pubescent leaves than the perennial red clovers. Even the kind usually denominated English red clover comprises somewhat numerous and continually altering subvarieties; and receives modifications and changes, not only from the diversified soil and culture of different situations, but from frequent intermixtures and substitutions of foreign seed; yet, in the aggregate, it may be regarded as having large seeds, a deep colour, and a powerfully luxuriant habit. The French red clover has small, plump, purplish seeds, roundish leaflets, very smooth leaves and stems, and a luxuriant and sappy appearance; and is well adapted for strong soils in warm or sheltered situations. The Dutch red clover has large, ill-filled, yellowish seeds, a somewhat light colour, and a rank and coarse habit of growth; but is well-suited to coarse clayey soils, cold, ill-drained land, and exposed or damp farms. The American red clover has small, yellowish seeds, small and hard stems, and only a moderate habit of growth; but is more easily prolonged into a duration beyond biennial than any of the other varieties. The Normandy, the Holstein, and the Cologne clovers likewise figure in our lists of biennial red clovers; but they are neither prominent nor well-tested.

White, creeping white, or Dutch clover, *Trifolium repens*, is an universally known indigenous perennial. It grows wild in our meadows and pastures, and possesses such extraordinary vitality in its seeds as, under favourable circumstances, to spring profusely and spontaneously up, in places where it could not previously have vegetated for very many centuries. Its roots are fibrous; its stems are stoloniferous, or creep along the ground, and strike root at the joints; its leaflets are heart-shaped, and frequently have near their base a black or darkish-coloured blotch; its flower-stems are erect and leafless; its flowers are arranged into globular heads, bloom from May till September, and are commonly white, but sometimes have a tinting of very light pink; its calyxes are unequally toothed; and its pods are four-seeded. It is suited to a very wide variety of soil and climate, and probably excels every other agricultural plant of Europe in the breadth and unscrupulousness of its adaptations. Varieties of it, more or less productive and nutritive, are somewhat common, and, so far as they are produced by mere peculiarities of soil and culture, may be regarded as fugitive; but one very marked variety of it has both a curious and a permanent character, is so five-lobed in its leaves as to be rather a cinquefoil than a trefoil, occasionally excites the curiosity and provokes the search of the rambler in the fields, and has received from systematic botany the designation *Trifolium repens pentaphyllum*.

The hybrid or bastard species, *Trifolium hybridum*, grows wild in Finland, Denmark, Germany, France, Portugal, and Italy, and was introduced to Britain in 1777. It was first discovered growing luxuriantly in ditches at Alsike in Sweden; and it has hence been sometimes called Alsike clover. It exhibits an appearance intermediate between that of *T. pratense* and *T. repens*, and was in consequence thought to be an offspring of their union, and designated hybrid or bastard; but it is, in all respects, a perfectly distinct species. Its root is fibrous and perennial; its stems are branchy, and not so erect as those of red clover; its leaflets are ovate and a little serrated; its flower-heads are globular and stalked; the tuft of its calyx is nearly equal; and its pods are tetragonal. It strikes its roots deeper, lifts its head higher, and has a more luxuriant foliage than the red clovers; and, besides being suitable both for the alternate husbandry and for laying down to pasture, it may probably flourish on a farm which, in reference to the red clover, has, in technical phrase, become "clover-sick." When made into hay in the northern parts of continental Europe, it retains its smell and colour, and never becomes mouldy; and either in hay or in a green state, it is eagerly eaten by all kinds of live stock.

The zigzag species, also called marl-grass, cow grass, and mediate cow-grass, *Trifolium medium*, grows wild in the dry pastures of England. It

is perennial, unfastidious, and of easy culture; yet, though thoughtlessly extolled by some agricultural writers, it has the character far more of a weed than of an useful plant. It is seldom, and in but small quantities, eaten by cattle; it produces comparatively little seed; it exerts so powerful a lateral action by its creeping and spreading roots as to starve and smother almost every grass-plant in its vicinity; and, while so unsocial and usurping as to take entire possession of spots of ground, and always exist in considerable patches, it loves only such situations as very dry and almost barren fields, very dry banks, and the earth-clad sides and summits of old walls. It has often been mistaken for common red clover, and, besides sharing with it the popular name of cow-grass, it has a considerable resemblance to it in general appearance; yet it may be readily distinguished by the creeping habit of its roots, the rigid, zigzag character of its stems, and the unspottedness and comparative narrowness and darkness of its leaves.

The Alpine species, *Trifolium alpestre*, grows wild in Hungary, Austria, and other parts of continental Europe, and was introduced to Britain in 1789. It has sometimes been confounded with the zigzag species; but is quite distinct in at once appearance, habit, and utility. Its root is perennial, and more fibrous yet less usurping than that of the zigzag species; its stem is erect, very hard, not much branched, and only about 12 or 14 inches high; its foliage is comparatively scanty; and its flower-heads are somewhat oval, and grow in pairs, and possess so comparatively high a degree of beauty as to render it very worthy of a place in the parterre. It has been recommended for farm-cultivation by continental writers; but it affords little promise of being able to compete with any of our present cultivated kinds in either succulency or luxuriance.

The strawberry-headed species, *Trifolium fragiferum*, grows wild on moist grounds in the seaboard districts of England. It is a perennial, and has a creeping and stoloniferous habit similar to that of red clover; but it is readily distinguished by the lowness of its growth, the inflation of its calyxes, the flesh or lightish-pink colour of its flowers, and the globose, strawberry-like appearance of its heads. Its root is fibrous; its stem is creeping; its leaflets are obcordate and serrated; its flower-stems seldom rise higher than about 3 or 4 inches from the ground; and its calyxes are inflated, membranaceous, coloured, and downy, and have two of the teeth of each recurved. This species, though hitherto little attended to, might probably be an advantageous ingredient in a mixture for permanent pasture on moist land.

The yellowish-white species, *Trifolium ochroleucum*, grows wild on dry pastures in some parts of England. Its root is perennial; its stem is erect, and about a foot high; and its flowers are sulphur-coloured, bloom from May till July, and

have so handsome an appearance as to entitle it to a place among ornamental plants. This species does not seem to deserve extensive cultivation; yet it might form a good ingredient in permanent pastures on dry and calcareous land.

The Hungarian species, *Trifolium pannonicum*, was introduced to Britain from Hungary in 1752. Its root is fibrous and perennial; its stem is strong, upright, and about 14 inches high; and its flowers have a white or whitish-yellow colour, and bloom in June and July. It has so much beauty as to be worthy of a place in the parterre; and, were it not too tender for general field cultivation, it probably possesses sufficient economical value to deserve the attention of the farmer.

The brown or villous-stalked species, *Trifolium badium*, is a native of the Pyrenees. Its root is fibrous and perennial; its stem is erect, and only about 6 or 8 inches high; its foliage is scanty; its flower-heads are numerous, have a bright shining yellow colour, and bloom from June till August; and its seeds disperse themselves as soon as ripe, and cannot easily be obtained for artificial sowing. This species is an ornament to the parterre, but seems to be of small agricultural value.—All the species we have hitherto noticed, excepting the biennial varieties of the red clover, are perennials; and all the species which remain to be noticed are annuals.

The crimson or flesh-coloured species, *Trifolium incarnatum*, is a native of Italy, France, and Switzerland, and was introduced from the first of these countries to Britain toward the close of the 16th century. Its stem is strong, striated, branched, hairy, and about 12 or 14 inches high; its leaf-stalks are long and downy; its leaflets are cuneiform, broadly-obtuse, crenate, and hairy; its flower-heads are oblong, obtuse, and about two inches in length; its flowers have a beautiful deep flesh-colour, and appear in July; its calyxes are ten-ribbed, hairy, and a little compressed; and its capsules are included in the tubes of the calyxes, and contain each a single, oval, compressed, glossy, yellowish-brown seed. It is largely cultivated in the south of France, and seems abundantly worthy of agricultural attention in Britain; and, while very productive of fodder in the field, it makes a fine figure in the flower-garden. In the south of France and in other continental districts, it is sown in the end of August or beginning of September, cut down in the following May, and immediately succeeded by a crop of potatoes or of Spanish wheat. Much stupid discredit has been thrown upon it in consequence of absurd experiments, which either assumed it to be a perennial or treated it as a spring-sown annual; and doubts have been raised against its adaptations to Scotland, in consequence of its refusing to flourish there under the same treatment as in the south of England.

Moliner's species, *Trifolium Molineri*, is a native of the south of Europe, and was introduced

to Britain in 1820. It pretty closely resembles the crimson species in at once height, appearance, and general habit, and has even been sometimes regarded as merely a permanent variety of that species; but it rushes more rapidly to maturity, has rather a hardier constitution, and carries a much lighter-coloured flower. It is cultivated in some districts of France and Switzerland, and probably might be more suitable than the crimson species for Scotland. Its appearance is decidedly handsome, yet not so imposing as that of the crimson.

The Alexandrian species, *Trifolium Alexandrinum*, is a native of Egypt, and was introduced thence to Britain in 1798. It rivals the crimson species in beauty, and even competes with it in intrinsic value; yet it has a more straggling habit of growth, and is less densely covered with foliage. Its stem is branching and nearly erect, and attains a height of from 12 to 24 inches; its leaflets are long, narrow, smooth, and slightly toothed; its calyxes are hairy, and have narrow, sharply-pointed, and unequal teeth; its flowers have a pale yellow colour, and appear in June and July; and its flower-heads are stalked and slightly oblong or oval.

The thread-like or yellow-suckling species, *Trifolium filiforme*, grows wild on the gravelly pastures and other dry, gravelly, or rocky places of Britain. It yields but a small bulk of forage, and is but little relished by any kind of live stock; yet it has been recommended for cultivation on such gravelly, rocky, or otherwise half-barren ground as cannot maintain more valuable herbage; and though usually an annual, it becomes, under good treatment or when eaten down by sheep, practically a biennial. Its stems are procumbent; its leaflets are nearly sessile; its flower-stalks are slender and bending; and its flower-heads are small, loose, five-flowered, and bright yellow.

The procumbent hop species, *Trifolium procumbens*, grows wild in the same kind of places as the thread-like species, and has a very similar character and value. Yet it is more compact, erect, and branching; it has usually a height of only from 4 to 6 inches; it has close, globular, shining yellow flower-heads; it is exceedingly liable to mildew; and it appears to be very generally disliked by cattle.—The lesser yellow species, *Trifolium minus*, also grows wild in dry gravelly places; and it has a similar habit and worthlessness to the procumbent species, but is seldom more than two or three inches high. *T. filiforme*, *procumbens*, and *minus*, are frequently cultivated under the common name of yellow clover, and are, in practice, often confounded with black medick, *Medicago lupulina*.—The starry species, *Trifolium stellatum*, grows wild upon the southern coasts of England, but is nowhere abundant. It has a height of 6 or 8 inches, and carries a curious head of purple-coloured flowers, but is not worthy of cultivation.

The principal species of clover at present approved and extensively cultivated in Britain are thus, the crimson, in preparation for summer fallow or for a crop of potatoes,—the white, and occasionally some other low-growing species, for laying down land to permanent pasture,—and the red for the purposes of the alternate husbandry, and for green fodder and hay. But whatever other species may, at any future time, come into cultivation, are likely to be treated in the same manner as one or other of these; so that all clovers, viewed in either their actual or their possible connexion with the farm, take as their type either the annual crimson, the perennial white, or the biennial red.

Crimson clover requires to be the subject of considerably more extensive observation and prolonged experience than have yet been directed to it, before it possess an established and routine system of cultivation for every part of Britain. "It has," says Mr. Lawson, "been grown with much success in England, particularly in the southern counties; but hitherto its culture has not been attended with the expected success in most parts of Scotland. Whether this want of success should be attributed to the effects of climate, or to the mode of culture, has not yet been satisfactorily ascertained. In England, it has been found to succeed best, either drilled (in rows at the distance of eighteen inches to one foot), or sown broadcast on stubble after the corn crops have been removed, and with no previous preparation save a course or two of harrowing, just sufficient to stir the soil to the depth of an inch or two, so that the seed may be more easily covered. In very tenacious soils, a very shallow ploughing is given; but in general, it is found better to dispense with the plough altogether, for the many failures which occurred previous to its culture being properly understood, are now attributed entirely to the ground having been too much loosened and pulverized by repeated ploughings. The advantages to be derived from the cultivation of *T. incarnatum* are, that when sown in autumn, it may be cut and cleared from the ground in the beginning of June following, and the land fallowed for wheat or spring corn; it forms a valuable green food for cattle at an early period of the season, and, if cut when in full flower, it yields a more abundant crop, and makes a superior hay to that of common clovers, at least it is more readily eaten by horses. There can be no doubt but the south of England is better suited for the growth of crimson clover than any part of Scotland. from the circumstance that the corn crops are much earlier removed, consequently the young plants have more time to attain strength before the winter season sets in; however, it does not follow but that it may be grown with advantage in the more favourable districts of Scotland, were its culture fairly understood. In England, about 18 lb. or 20 lb. of seed is allowed to the acre; but in Scotland it

has been thought advisable to add a few pounds more, to provide against contingencies; when drilled, of course, the quantity required will be less, and it may be increased or lessened according to the nature of the climate and soil."

White clover has neither a proper habit nor a sufficient productiveness to be grown either as an independent crop or as a member of any course of alternate husbandry; but it is eminently suited for herbage in any kind of pasture or grass lands, and ought always to be mixed in tolerably large proportion with the artificial grasses, in laying down land to what is technically called permanent pasture. Though creeping and of low growth, it luxuriantly intertwines with the grasses, so as to form a thick and massive mat of herbage; and it is at once so sweet and so very nutritive as to serve, in the highest manner, all the immediate purposes of pasturage. Yet when any instance of "permanent pasture" is intended to be of comparatively short duration, and to serve quite as much the remote purposes of an arable rotation as the immediate purposes of grazing, white clover is much less suitable than perennial red; for not only is it slower of development in the earlier periods of its growth, but it exerts a far feeblower manurial power upon the soil for the succeeding cereal crops. Its proper place and treatment, therefore, are prominence among the grasses of a long continuance of artificial pasture, and intermixture with the seeds of those grasses at the time of their being sown. It flourishes upon almost any soil, no matter how heavy, provided it be sound and dry; but it thrives best upon light calcareous soil; and, in very many instances, it springs, as if spontaneously, from seeds which have been dormant for ages, either after the turning up of light calcareous land which has long lain in waste or neglect, or after a smart and prolonged action of calcareous manure upon other kinds of land.

Red clover is an important element in all good alternate husbandry; but has, in a considerable degree, come to be distrusted, or to be considered as precarious, in consequence of having generally been cultivated on too close and routine a system, or at too rapid intervals. On its adoption into British agriculture, it exploded the old triennial system, and led the way to all the valuable modern improvements in courses of cropping; and its presence or absence, its prominence or obscurity, its profusion or sparseness in any district, is still a very distinct indication of the excellence or wretchedness of that district's husbandry. It affords ample support to the remunerating practice of soiling cattle, and, with the aid of tares, may form a sufficient supply of green food for all stock from the beginning of May till the end of November; it so covers the ground with its broad foliage, as to smother annual weeds; and it so enriches the soil by the fixation of gases, and the profuse ramification of its roots, as to act with the power of a fallow, and make

both a mechanical and a chemical preparation for a beautiful and luxuriant cereal crop. But when frequently repeated, or when grown at regularly recurring intervals, without efficient means being used to counteract the mischief done to the soil, it is, in numerous situations, exceedingly liable to serious and even very signal failure. In Belgium, it cannot, under the present system of Flemish husbandry, safely recur oftener than at intervals of eight or ten years; in Norfolk, it ought, according to the locally approved system of rotation, to recur in every fourth year, but frequently requires to be either substituted by grass-seeds or pulse, or nursed and protected by a special application of mineral manure; in the magnesian-limestone districts of England, it fails, on the average, to the amount of about four-ninths of the entire surface on which it is sown; in the oolitic districts, and in such parts of the coal and the new red-sandstone districts as have a light soil, it is esteemed precarious at a shorter interval than about twelve years; and on the chalk wolds of Yorkshire, it has so often and egregiously failed as to have become almost totally abandoned. In the last of these districts, indeed, even white clover, when grown as a substitute of the discarded red, very often fails to the amount of one half of the surface sown.

A crop of red clover which fails in consequence of too frequent sowing, or in the manner of what is technically called clover-sickness, springs up, and vegetates till after the harvesting of the cereal crops with which it was sown, and then dies away during the months of October, November, December, January, February, and March. The cause of its failure has been a subject of great bewilderment to farmers, and of much controversy among scientific agriculturists. A somewhat favourite opinion ascribes the failure to an exhaustion of some constituents of the soil, which are required for the sustenance of clover, and points to a manurial supply of these constituents, particularly of gypsum, common salt, and phosphate of lime, as a means of preventing the failure; and another opinion, with nearly equal plausibility, ascribes it to the presence of some vegetable excretions which are poisonous to clover, and points for a remedy either to the chemical decomposition of the offensive matters, or to the avoiding or modifying of the particular crop by which they are deposited. But the chief cause, and probably the only one, appears to us to be the destruction of the cellular tissue of the plants by frost,—or remotely the absence or considerable diminution of the soil's cohesiveness, and of its consequent power of retaining heat. "Those plants, particularly clovers, which are impatient of sudden change of temperature, are readily destroyed by the frost; and soils, by the growth of white clover, red clover, and tares, become more pulverulent, puffy, and less cohesive, in proportion to the frequency of the growth of these crops; and this explains why these lands

tire of clover. The several particles of earth, by the long, deep, and numerous radicles of these plants, become mechanically forced from their position, and their points of contact thus rendered fewer in number; and such soils comparatively become specifically lighter in proportion to the weight of a determinate volume." A scientific paper, by the Rev. W. Thorp, in the Journal of the Royal Agricultural Society of England, makes an able appeal to experiment, in vindication of this opinion and in refutation of the prevailing opinions, and then shows how perfectly this opinion harmonizes with the numerous and hitherto perplexing phenomena of clover-sickness.

The soils of the chalk, oolite, and magnesian-limestone districts of England, after losing their power of producing clover, re-acquire it by the enjoyment of a considerable period of rest. For, "the more frequently the clovers, or tares, or any large tough-root plant are sown, the less compact and lighter in weight does the soil become; and at length, there is produced from this cause an incapacity of the clovers growing upon them to resist the frost; yet, in time, by the decomposition of these roots, and the cultivation of bulbous-rooted crops, and the treading of the soil by sheep in eating them off, as is usually practised, reconsolidation of the soil takes place, and the same land is thus enabled again to sustain clover against the severity of the frost."—In some fields, particularly on the wolds of Yorkshire, the clover sometimes remains alive and healthy on the headlands, after it has everywhere else perished; and it appears to owe all its safety on the headlands to the incidental circumstance of their having been trampled and comparatively consolidated by the horses when turning round in ploughing.—Clover after teazles invariably fails on the strong tenacious clay lands around Hemsworth; and yet clover after teazles succeeds better than any other crop, in the magnesian-limestone districts, particularly around Kirk-Smeaton. For the treading of the teazle-spittalers and reapers renders the clay land so compact as to exclude the proportion of air necessary for supporting the clover; while just the same thing renders the light and porous limestone sufficiently solid for preserving the crop through the winter.—One portion of a field which had received farm-yard manure in preparation for turnips has been found to maintain clover, while another portion of the same field which had received bone-manure in preparation for turnips has been found to let the clover perish; and the former of these portions seems to have owed much of its superiority to the binding or agglutinating action of the dissolved dung, while the latter owed much of its inferiority to the loosening and separating action of the slowly decomposing bones.—Some parts of the magnesian-limestone districts will produce clover every fourth year, and others will produce it only every eighth year, others only every twelfth year, and others not at all; for "the

compactness of the limestone soils is very variable,—some require pressing for wheat, others do not,—some contain five per cent. of alumina, others not one per cent.,—some twelve per cent. of lime, others not two per cent.,—hence, upon the more compact the clover will stand the winter, while upon other portions it will not do so."—In farms in the south of England which have a light and porous soil, a working flock of sheep very generally secure the successful cultivation of clover; for, by their treading and their droppings, they both consolidate the soil and increase its capacity for heat.—The claying or marling of clover-sick lands in Norfolk frequently restores their power of bearing clover; because it so changes their mechanical texture as to render their particles cohesive, and their whole substance less penetrable by frost.—The chalking of the Yorkshire wolds, or the liming of many lightish lands in other districts, is favourable to clover,—simply because it increases their tenacity; and so sensibly has the chalking this effect, that a person, walking over almost any portion of the wolds may know, from the sensation of firmness or otherwise conveyed through his feet, whether it have been chalked.—"Sprengel remarks that the clovers delight in a close-topped soil, or one which admits no great quantity of oxygen to the roots. The best clover grown in Great Britain is upon the warp soil in marsh land near the river Humber; for not only is such a soil dry and compact, but abounds in microscopic animalculæ. Ehrenberg has discovered that the mud of the various harbours in Europe contains from one-third to half of its volume of distinguishable organic bodies, chiefly polythalamia, from the nitrogen of which no doubt these soils derive their general fertility."—The practical and very important inference from all this is, that tendency to clover-sickness may, in every instance, be successfully combated, and that, by rolling, pressing, claying, chalking, liming, or other consolidating appliances adapted to the specialities of the various kinds of soil, it may be completely and quite cheaply vanquished. "I should say," remarks the writer whom we have been following, "lime the clover-ley when broken up for wheat, press the wheat, and also press the soil for barley, and after harvest, before November, roll the barley with a heavy roller, and the probability is, that we should hear no more of clover-sick lands."

Red clover is always sown in spring, and very seldom sown alone. It evolves so small a bulk of produce in the first year that it could not remunerate by being sown alone; and it enjoys positive advantage from the presence of another crop, which shall not remain longer on the ground than till August or September; and in all ordinary cases, it detracts from the nourishment which the soil might yield to the accompanying and overshadowing crop, no more than it compensates by its own value. On strong clayey

land in England, and on all kinds of wheat-bearing land in Scotland, it is frequently sown in spring among the rising crop of winter-wheat; on all kinds of land in Norfolk, and on light lands in some other British districts, it is always sown among barley; in Belgium, it is sown among rye; in the southern and midland counties of England, it is sown among barley, oats, or any other convenient crop, and considered the best preparation, except clean fallow, for wheat; and on any rich land, it may advantageously be sown among flax which is intended to be pulled green. A chief advantage of sowing it among a rising crop of wheat, or any other winter crop, is to prevent injury to that crop from premature luxuriance in the clover; and a disadvantage of such sowing, especially if the rising crop be thick, is the risk of the clover-seeds or young clover-plants not obtaining sufficient circulation of air for their vegetating.

The proper quantity of seed, on strong clayey lands, with wheat or oats, varies from 12 to 18 pounds per acre; and, on light porous soils, with barley, from 10 to 14 pounds. When the weather is favourable, and a range of proper time is in the farmer's option, clover ought to be sown as early in the spring as possible, in order that it may escape the possible mischiefs of drought and of insect devastation. When unmixed with grass-seeds, it is always sown broadcast; and, except in the hands of a singularly expert sower, it ought, for the sake of securing the utmost possible equality of distribution, to be sown one-half lengthwise and one-half across. It requires a finely pulverized soil, and a very thin covering; and the sowing of it should be immediately preceded by finely-tined harrowing, and immediately followed by bush-harrowing, and, on light soils, by rolling. On heavy soils, among oats, it is usually sown in March; among rising wheat, either while the wheat-plants are low and slender, or after they have been eaten down by sheep; and on light soils, among barley, after turnips, in the course of April, or even so late as the beginning of May. Under bad management, as to either insufficient tillage or unskilful sowing, or in unfavourable seasons, from the effects of drought or of frost, the clover crop may partially fail or may come up in mere patches; and in all such instances, tare-seeds ought to be either dibbled in, or sown and harrowed in upon all the vacant spaces.

A small proportion of the seeds of rye-grass, *Lolium perenne*, usually about a peck per acre, is, in multitudes of instances, mixed with the clover seeds in sowing. This intermixture of rye-grass is supposed to assist in preventing clover-sickness, to nurse and shelter the young clover plants, to augment the profitable bulk of the clover crop, and to serve as a corrective of the heating properties of clover hay, and otherwise improve its good qualities as provender. So long as the intermixed rye-grass of the crop is young and suc-

culent, clover-hay which contains it is at least as good as pure clover-hay, and perhaps a little better; but when the rye-grass becomes old and hard, it unquestionably deteriorates the crop. Unmixed clover-hay always or almost always obtains, around London, a superior price to mixed clover hay; but in many, perhaps most instances, it owes its higher market value to mere prejudice. When clover is intended to be strictly biennial, it probably acquires little advantage, and may occasionally suffer detriment from an intermixture of rye-grass; and when it is intended to stand to a third or a fourth year, it not only is benefitted by the presence of the rye-grass, but requires a selection of its own perennial varieties, and may very profitably have from two to four pounds per acre of its red clover seeds at sowing substituted by the same quantity of seeds of white clover. "If the grass is to continue in the ground only one year," says Mr. Stephens, in reference to the practices of Scottish farming, "a larger proportion of red clover is used than when it is to continue for two or more years. It is considered that 12 lb. of clover seeds and one bushel of rye-grass, is sufficient for an imperial acre. If the grass is to continue one year, the rye-grass should be the annual, and so called because it only affords a crop for one year, though by that time it has been two years in the ground,—one with the crop in which it was sown, and one with the clover seeds,—and though there is no botanical distinction between it and the true perennial rye-grass. This seed weighs 30 lb. per bushel, gives 1,712 grains to one drachm weight, and costs, by the quotations of 1843, from 20s. to 28s. per quarter. For the same duration of the grass crop, 10 lb. of red clover and 2 lb. of white should be sown on the acre. The red clover weighs 64 lb. per bushel, and gives 2,000 grains to one drachm, and the cost is from 56s. to 75s. per cwt. The white clover weighs 65 lb. per bushel; and, though so heavy a seed, it is so small that it takes 4,000 grains to weigh one drachm; and its usual cost is from 56s. to 75s. per cwt. When the grass is to remain more than one year, 6 lb. of red and 6 lb. of white, and one bushel of true perennial rye-grass, are considered good proportions. The perennial rye-grass weighs 18 lb. per bushel, gives 2,000 grains to one drachm, and its cost usually is from 24s. to 48s. per quarter." The mixture of other hay and pasture plants besides rye-grass with clover—particularly *Lolium Italicum*, *Phleum pratense*, *Dactylis glomerata*, *Plantago lanceolata*, and *Petroselinum sativum*—has of late years been recommended; but any such mixture belongs rather to the systematic cultivation of the grasses, than to the clover-fallow of regular arable rotations. See the article GRASS. Whenever a farmer purchases clover seeds from any party in whom he has not perfect confidence, he ought to satisfy himself that they are not "doctored." See the article SEEDS.

The destination of the clover crop is exceedingly various; and the treatment of it must, in a main degree, be ruled by the destination. In favourable seasons, and on rich soil, it frequently attains a considerable height and luxuriance before the commencement of corn-harvest; and, in such instances, the corn crop amongst which it grows may be cut very low, so that a portion of the clover may be mixed with its straw, and add to the sweetness, nutritiousness, and bulk of its fodder. But when, from any cause, the clover continues to be low and feeble till the time of corn-harvest, it ought to escape all touch of the instrument at the cutting of the corn-crop; and it may afterwards shoot up with such rapidity as, before the close of the season and without injury to itself, to afford a hearty though cautious bite to a flock of sheep. In all situations, unless when it suffers some disaster, or is diverted from its natural course of productiveness, it yields two disposable crops in the second year,—the first and best, when it is coming into flower in the beginning of summer, and the second when it has again rushed into full vigour in autumn; and in some very favourable circumstances of soil, situation, and weather, it even, during the second year, produces three good disposable crops. The most common practice is to make the first of the two crops of the second year into hay, and to feed off the second crop; and another common practice, though a severe one, is to make both crops into hay. But these practices are, in multitudinous instances, superseded or greatly modified by others. Many farmers turn their stock upon clover as early in spring as it will afford them sustenance, and keep them upon it till May; and some afterwards treat it for a crop of hay, while others let it stand for a crop of seed. In general, in the vicinity of large towns, clover is treated as much as possible for hay; in districts remote from large towns, it is always more or less liberally fed off, and occasionally cultivated for seed; and when prolonged into the third year after sowing, it is usually pastured or fed off in a similar manner to turnips.

The general hay-making process with clover, as well as with meadow-grass, will be noticed in the article on HAY. The grand difficulty in the case of clover is so to dry it, as to avert the risk of moulding, and prevent damage to its tender foliage; and this difficulty is increased when, in order to insure the due richness of the hay, the clover is not cut till fully in flower. In most ordinary and all careless methods of hay-making, both the foliage and the flowers of clover are in imminent peril of being destroyed; nor is any method safe which shakes or disperses the swathe, or which does more than regularly and cautiously turn it. The mere drying of the crop is, in any circumstances, tedious, and in wet weather impracticable. The German agriculturist Schwertz dries the clover on a sort of parrot perches, stuck into the ground. The perches are about 8 feet

high, and capable of bearing a load of 2 cwt. of green fodder, mowed 24 hours, and in a somewhat withered condition. "This method, as I have seen it practised in the Duchy of Baden," says Bousingault, "answers well; but there is considerable cost for manual labour, and, in the first instance, for perches." But a cheaper, easier, and far more economical method was invented, tested, and published, a few years ago, by William Bell, Esq. of Hunthill. He originally designed merely to avert the injury which usually arises from letting the clover lie in swathes just as it falls from the scythe; but he obtained results which involved the superior preservation, colour, fragrance, and nutritiousness of the hay. Mr. Bell, writing to the Directors of the Highland Society, in the beginning of the winter of 1839–40, says: "On Thursday 26th September, 1839, an acre of a heavy second crop of clover was cut. On the same day, a stack of oats was thrashed, being also the produce of about an acre; and the straw was spread on the surface of the grass as it lay on the ground. That same evening, the whole, without being worked up in any way, was put into hand-ricks. On Saturday the 28th, the whole was spread out; and in the evening, it was put up in larger ricks, about three of the first in one. On Monday the 30th, the whole was again spread out, and in the evening was put in larger ricks, standing about six feet high. It was then considered to be quite ready to be carried to the stack; but on Tuesday the 1st October, the weather, which had been good, changed, and a heavy rain wetted the whole to a serious extent. On Thursday the 3d October, however, on being once more spread out, the whole was found to be so dry, that it was put up in large tramp ricks, in which state it stood for about two weeks. It was then stacked, and has remained ever since in the best condition, no part of it having become at all heated, and the whole being as fragrant as the best clover hay. Horses preferred it greatly to the hay of this season of good quality, and the straw was eaten as readily as the grass, with which it is intimately mixed." And after he had experience of it till the end of spring, 1840, he said, "The cattle and horses have eaten it freely, and continue to do so till the present time. Where a quantity of the clover happens to have been kept together, it is brown in colour, as is usual with the best clover hay; where it has been intimately mixed with the straw, the stem and leaf remain essentially green, and the flower red; the whole mixture is fragrant, and in excellent condition." This method, therefore, besides facily and cheaply averting mischief from the clover, secures a large, easy, and most profitable increase of prime winter food for cattle and horses, and may prove eminently beneficial in rainy districts or in bad hay seasons.

On good land, the first crop of hay will produce two tons of hay per acre, and the second crop one ton and a half; and if the land be very highly

manured, the produce will be considerably greater. In the Woburn experiments, on rich clayey loam, the produce per acre of newly cut broad clover was 49,005 lbs., and of long-rooted clover 74,868 lbs.; and on rich black loam, the produce per acre of newly-cut bastard clover was 20,418 lbs. Schwertz reckons that 2 cwts. of green clover yield 48 lbs. of hay; but the proportion of the dried hay to the green crop is very materially ruled by the age of the plants, and by the meteorological circumstances under which they grow. In experiments of Boussingault, one ton of clover in flower of the second year yielded 7 cwts. of hay, and one ton of clover of the first year yielded 4 cwts., 2 qrs., 24 lbs. of hay; clover hay sent off, by complete desiccation, 21 per cent. of moisture; dry hay yielded, by incineration, 7.76 per cent. of ashes; and the elementary constituents of the organic parts of dry hay, or the parts which were dissipated by combustion, were 47.53 per cent. of carbon, 4.69 of hydrogen, 37.96 of oxygen, and 2.06 of nitrogen.—*Loudon's Hortus Britannicus*.—*Sinclair's Hortus Gramineus*.—*Lawson's Agriculturist's Manual*.—*Lawson on the Artificial Grasses*.—*Young's Farmer's Calendar*.—*Reports to the Board of Agriculture*.—*Marshall's County Reports*.—*Quarterly Journal of Agriculture*.—*Journal of the Royal Agricultural Society*.—*Catalogue of the Highland Society's Museum*.—*Transactions of the Highland Society*.—*Stephens' Book of the Farm*.—*Davy's Agricultural Chemistry*.—*Boussingault's Rural Economy*.—*Doyle's Husbandry*.—*Sproule's Agriculture*.—*The Gardener's Magazine*.—*Low's Agriculture*.—*Sir John Sinclair's General Report of Scotland*.

CLOVE-TREE,—botanically *Caryophyllus*. An evergreen, tropical, spice tree, of the myrtle tribe. It constitutes a genus of itself, and takes for its specific name *aromaticus*. It is a native of the Moluccas; it is cultivated, for the sake of its cloves, in the islands of Amboyna, Honimoa, Oma, Nousalaut, Sumatra, Bourbon, and Dominica; and, in 1797, it was introduced, as a curiosity, to the hothouses of British gardens. Its stem consists of extremely hard wood, and is covered with a thin, smooth bark, like that of the beech; its branches so ramify and ascend as usually to attain a height of 20 or 25 feet from the ground; its leaves are opposite, lanceolate, smooth, dull green, and very similar in form and consistency to those of the laurel,—and, when bruised, they diffuse a strongly aromatic odour; and its flowers grow in bunches of from nine to twenty-one at the extremity of the branches,—their calyx is long, and divided into four segments,—their corolla has four roundish, notched, very pale blue petals,—and, in their native country, they appear in March. The unexpanded flowers, or the calyxes previous to the development of the petals, are the cloves of commerce, and are gathered from the beginning of October till the end of February. They are shaken down upon large cloths spread under the trees; they have, at the

time of being gathered, a reddish colour, and a certain degree of firmness; they are immediately immersed in boiling water,—then spread upon hurdles, covered with leaves, and exposed for a few days to smoke and a strong heat, till they acquire a brown hue,—and then spread out in the sunshine till they become thoroughly dry. Prime cloves are comparatively large-sized, heavy, oily and frangible, of a fine fragrance, and very pungent aromatic taste; and when handled and finger-pressed, they should make the fingers smart, and leave upon them a greasy moisture. A powerfully aromatic oil is distilled from cloves; and the best varieties of this are prepared in the Moluccas, and sent to Europe in bottles. A peculiar crystallizable principle, apparently a sub-resin, was obtained by M. Lodibert from the cloves of the Moluccas and the West Indies, and designated by him caryophylline. Cloves, besides their well known culinary uses, possess valuable medicinal virtues, as powerfully stimulating aromatics, and are given as corrigents to other medicines, and as principal remedies in atonic gout and bad cases of dyspepsia.

CLUB-GRASS,—botanically *Corynephorus*. A small genus of grasses, of the oat tribe. The white species, *Corynephorus canescens*, called by Sowerby and Smith *Aira canescens*, grows wild on the sandy shores of England. Its root is perennial; its culm is 6 or 8 inches high; its flowers appear in July and August; and its jointed beard terminates in a club-shaped articulation, which gives occasion to its popular name.

CLUB-MOSS. See LYCOPIDIUM.

CLUB-RUSH,—botanically *Scirpus*. A genus of perennial, cyperaceous plants of the rush or sedge tribe. They have somewhat the appearance of very coarse grasses, but develop their fructification in a different manner, grow on poor soil or in neglected situations, and always have the character of rank and coarse weeds. Their flowers, like those of the grasses, are glumaceous; and the spikelets are many-flowered and profusely imbricated. The lake species, bull-rush, or tall club-rush, *Scirpus lacustris*, abounds on the sides of lakes and rivers, on occasionally inundated alluvial soils, and in several other kinds of watery situations, and possesses considerable economical value. Its culm is about 6 feet high, round, filled with soft white pith up the centre, about half an inch thick at the base, and generally furnished at the bottom with two sheaths; its panicle is terminal and decompound; and its spikelets are ovate and smooth, and appear in July and August. It is used for making mats and chair-bottoms, for stuffing between the staves of casks, and for various other purposes; and it might be profitably cultivated in such periodically flooded alluvial grounds as are incapable of reclamation from fresh-water tides or from other similar inundations.—The tufted species, *Scirpus cespitosus*, has usually a height of 6 or 8 inches, flowers in July, and abounds in many bogs and

turfy heaths. The few-flowered species, *Scirpus pauciflorus*, has about the same height as the preceding, flowers in August, and occurs in mountainous bogs. The triangular species, *Scirpus triquetus*, has a height of about a yard, flowers in August, and grows in English marshes. The glaucous species, *Scirpus glaucus*, has a height of about two feet, flowers in July and August, and occurs in the salt marshes of England.—The species called *S. rufus*, *S. caricinus*, *S. sylvaticus*, *S. maritimus*, and *S. carinatus*, are also indigenous, and usually have heights of respectively $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, and 3 feet. Seven or eight species have been introduced from foreign countries; and upwards of an hundred others have been scientifically described.

CLUMP. A number of shrubs or trees growing together in an isolated group.

CLUSIA. See BALSAM-TREE.

CLUSTER. A raceme, bunch or group. The name is employed in such varied ways as to designate a raceme of flowers, a bunch of grapes or currants, and a clump in turnip-crops.

CLUSTER-GRAPE. The small black grape, or currant grape. See GRAPE and VINE.

CLUSTER-PINE. The pinaster. See PINE.

CLUTIA, or CLUYTIA. A genus of beautiful, evergreen, tender small shrubs, of the spurge family. Two species have been introduced to our hothouses from India, and ten to our greenhouses from the Cape of Good Hope; and several more are known to botanists. All the introduced species are handsome; all the Cape species are valuable for blooming in winter or early spring; and the species called *pulchella*, *alaternoides*, *daphnoides*, *polygonoides*, *tomentosa*, *polyfolia*, and *ericoides*, are the chief favourites. The flowers of all are white.

CLYMENUM,—botanically *Lathyrus clymenum*. A hardy, climbing, ornamental, leguminous annual, of the everlasting pea genus. It attains a height of 4 feet, and carries red and blue papilionaceous flowers in June and July. It is a native of the Levant. A subdivision of lathyri, comprising about a dozen species, takes the clymenum as its type.

CLYSTER. See GLYSTER.

CNEORUM. A small genus of beautiful evergreen shrubs, of the turpentine-tree tribe. The three-grained species, or widow-wail, *C. tricoccum*, is a native of dry gravelly soils in Spain, Italy, and the south of France, and was introduced to Britain in 1793. Its stem consists of very hard wood, and is 3 or 4 feet high, and very much branched; its young branches are smooth and pale green, and its old ones brown; its foliage is smooth, dark green, and very handsome, and combines with the arrangement of the branches to recommend the plant to a front situation in a shrubbery; and its flowers are yellow and inconspicuous, grow from the wings of the leaves, and bloom from April till November. Another species, called the powdery, *C. pulverulentum*, was

brought, in 1822, from Madeira.—The name *cneorum* is also the specific designation of three ornamental evergreen undershrubs of other genera. The *Convolvulus cneorum* has pink flowers, grows a yard high, and was long ago brought from the Levant; the *Pleurandia cneorum*, or garland-flower, has yellow flowers, grows two feet high, and was recently brought from the Cape of Good Hope; and the *Daphne cneorum*, or old garland-flower, has pink flowers, grows 15 inches high, and was brought, about the middle of last century, from Austria.

CNEPHASIA. See TURPENTINE-MOTH.

CNICUS. See THISTLE.

COACH. See CARRIAGE.

COAGULATION. See ALBUMEN.

COAGULUM. See CHEESE, CURD, BLOOD, and RENNET.

COAL. This well-known substance consists essentially of carbonaceous matter, and, in one variety, the blind coal (see ANTHRACITE), this is nearly pure; but, in the greater number of the varieties of coal, there is present a soft, bituminous matter, which communicates to them some peculiar properties. Those which contain much bitumen are highly inflammable, and burn with a bright flame; those in which the carbon predominates burn less vividly. Numerous varieties of coal exist, deriving distinctions partly from their state of aggregation, but principally from the proportions of their bitumen and carbon. Excepting the anthracite, they may be treated of under the two divisions of black coals and brown coals. The colour of brown coal, as its name imports, is brown: it possesses a ligneous structure, or consists of earthy particles. The colour of black coal is black, not inclining to brown, and it does not possess the structure of wood.

The varieties of brown coal are the following:—*bituminous wood*, which presents a ligneous texture, and very seldom any thing like conchoidal fracture, and is without lustre; *earthy coal*, consisting of loose, friable particles; *moor coal*, distinguished by the want of ligneous structure, by the property of bursting and splitting into angular fragments, when removed from its original repository, and the low degree of lustre upon its imperfect conchoidal fracture; *common brown coal*, which, though it still shows traces of ligneous texture, is of more firm consistency than the rest of the varieties, and possesses higher degrees of lustre upon its more perfect conchoidal fracture.

Some varieties of black coal immediately join those of brown coal. They are, *pitch coal*, of a velvet-black colour, generally inclining to brown, strong lustre, and presenting, in every direction, a large and perfect conchoidal fracture; *slate coal*, possessing a more or less coarse, slaty structure, which, however, seems to be rather a kind of lamellar composition than real fracture; *foliated coal*, resembling it, only the *laminae* are thinner:

and *coarse coal* in like manner, only the component particles are smaller, and approach to a granular appearance; *cannel coal*, without visible composition, and having a flat, conchoidal fracture in every direction, with but little lustre, by which it is distinguished from pitch coal. All these kinds are joined by numerous transitions, so that it often becomes doubtful to which of them we should ascribe certain specimens, though they undoubtedly are members of this species.

As the preceding varieties of coal consist of variable proportions of bitumen and carbon, they, of course, must vary in their inflammability. Several varieties become soft, and others coke, when kindled, or, in other words, allow of the separation of the bituminous from the carbonaceous part. We perceive this separation in its combustion in a common fire; the coal, when kindled, swelling and softening, exhaling a kind of bitumen, and burning with smoke and light; while, after a certain period, these appearances cease, and it burns only with a red light. The separation is effected more completely by the application of heat in close vessels: the bitumen is melted out, and there is disengaged ammonia, partly in the state of carbonate with empyreumatic oil, and the coal gas (a variety of carburetted hydrogen), often mixed with carbonic acid and sulphuretted hydrogen, the carbonaceous matter being, in a great measure, left, forming coke.—The decomposition of coal is carried on, on a large scale, with a view to collect the products; the gas being used to afford an artificial light, which is clear, steady, easily regulated, and economical; the bituminous matter, or mineral tar, being applied to the uses for which vegetable tar and pitch are employed, and the coked coal being used in the smelting of metallic ores, and for various other purposes, where an elevated and steady temperature is needed.

Coal, excluding anthracite, has been supposed to be of vegetable origin. There is a remarkable gradation from bituminated wood to perfect coal. In some varieties, the structure, and even the remains, of plants are apparent, and its chemical composition agrees with that of vegetable matter. It is difficult to determine, however, in what manner it has been formed, or by what operations the vegetable matter, from which it has originated, has been so far modified, as to have assumed the properties under which it exists. And there are many geologists who regard it, in common with anthracite, as an original mineral deposit.—The varieties called *slate coal*, *foliated coal*, *coarse coal*, *cannel coal*, and *pitch coal*, occur chiefly in the coal formation; some varieties of pitch coal, also the moor coal, bituminous wood, and common brown coal, are met with in the formations above the chalk; the earthy coal, and some varieties of bituminous wood and common brown coal, are often included in diluvial and alluvial *detritus*. The coal seams

alternate with beds of slaty clay and common clay, sandstone, limestone, sand, &c. They are often associated with vegetable organic remains, in slaty clay, sometimes, also, with shells, and having iron pyrites intermixed with them. Bituminous coal is so universally distributed, that it is unnecessary to attempt the enumeration of its localities.

COAL-ASHES. See ASHES.

COAL-GAS. The combustible aeriform product of the destructive distillation of mineral coal. Though often supposed to be a very simple and uniform gas, and though now almost universally known in Britain, it is both compound and exceedingly variable, and might easily be classified into a number of varieties. Its chief constituents are olefant gas and light carburetted hydrogen, in very variable proportions; and its most frequent secondary constituents are carbonic acid, carbonic oxide, free hydrogen, free nitrogen, some compound or compounds of sulphur, and several definite compounds of carbon and hydrogen. Some of the constituents, such as nitrogen, are useless; some, such as carbonic acid and carbonic oxide, diminish the illuminating power of the mixture; some, such as sulphuretted hydrogen, are noxious to organic beings; and some, including all the most important, are greatly modified in their illuminating power by the proportions of their combination. The quality of coal-gas is controlled by the character of the coal distilled, by the degree and regulation of the heat in distillation, by the method of purification, and by several other circumstances; and, even in any one manufactory, whose processes are not carefully and uniformly conducted, it may so exceedingly vary as to range between a specific gravity of .45 and a specific gravity of .70. In all public manufactories, it is more or less, and in some wholly, purified from its sulphuretted hydrogen by being made to pass through some watery preparation of lime; but, even after such purification, it contains a proportion of some compound of sulphur, and in consequence generates by its combustion more or less of sulphurous acid. Cultivators of plants, then, need not wonder that the burning of coal-gas is injurious to vegetation; and they may generally infer that any variety of coal-gas will damage their plants nearly in the proportion of the sulphuretted hydrogen or of the sulphuret of carbon which it contains. A singular explosion of coal-gas occurred, a number of years ago, in a hothouse, with a peculiarly constructed furnace, in the vicinity of Falkirk. Some fresh coals were put into the furnace, the door was shut, and the explosion immediately followed. The flues were burst with extraordinary violence; and so great was the heat, that vines and other plants were completely singed and spoiled.

COAL-SOOT. See SOOT.

COAT. The natural hairy covering of the domestic animals, and particularly the sleek and

glossy covering of a well-kept horse. See the article GROOMING.

COB. A wicker basket for carrying on the arm, or the small seed-basket carried by a sower; likewise, a mud-wall; and formerly also a spider,—hence the word cobweb.

COBÆA. A small genus of ornamental climbing plants, constituting the natural order Cobæaceæ, and recently separated by Mr. Don from the bignonias. The climbing species, *C. scandens*, is the only one in Britain, and was brought hither in 1792 from Mexico. It has pinnated tendrilled leaves, and large purple flowers; and it usually attains a height of from 20 to 40 feet, and blooms from May till October. It generally requires greenhouse protection during winter; and it grows with such amazing rapidity that, even where it cannot resist the effects of winter in the open air, it might be successfully and most ornamentally employed for covering bowers and rustic buildings. It is easily renewed every year from cuttings or from seed.

COBURGIA. A genus of very beautiful, tender, bulbous-rooted plants, of the amaryllis tribe. The vermilion species, *C. miniata*, was introduced to Britain from Peru in 1844. Its leaves are bright green, three feet long, and an inch broad; its flower-stem rises to the height of three feet; and its flowers are drooping, narrow, tubular, and about $2\frac{1}{2}$ inches long,—they are produced in a cluster at the top of the flower-stem,—and they are at first nearly white, but afterwards become overspread with a vermilion tint. The scarlet species, *C. coccinea*, was introduced from Lima in 1839; and has considerable affinity, in the form of its flower, to *Carpodeles recurvata*. The flesh-coloured species, *C. incarnata*, was brought from Quito in 1826, resembles a pancratium, grows two feet high, has a light scarlet flower, and produces an imposing effect.

COCCINELLA. A large genus of coleopterous insects, forming the type of the Coccinellidæ tribe. About thirty species have been observed in England; and are as varied among themselves in colour and markings as any of our domestic animals. They are beautiful objects; they have always been popular favourites; they everywhere secure the admiration and good feeling of children; and they bear the pet names of lady-birds and lady-cows among ourselves, and vache-a-Dieu and bêtes de la Vierge among the French. They hybernate in dry fallen leaves, in the cracks of palings, beneath the loose bark of trees, and in similar situations; they are allured from their retreats by sunny days so early in winter as December; they sport freely and finally abroad at the earliest period of true spring; and the females, at the last of these periods, lay their eggs, in clusters of about fifty, beneath leaves. The eggs are cylindrical, buff-coloured, and set on end; and the larvæ, *Plate XVI., Figs. 17 and 18*, are of a leaden colour, with orange or scarlet spots. They speedily emerge from the eggs, and

spread themselves over palings, the foliage of trees, and the grass of the fields, there to commence a course of devastation among the aphides. See the article APHIS. Two of the most numerous and beneficial species of Coccinella, *C. bipunctata* and *C. septempunctata*, *Figs. 20 and 21*, may be noticed both for their own sakes, and as illustrative specimens of the whole genus.

The two-spotted coccinella, though always convex, about $2\frac{1}{2}$ lines in length, and quite specifically uniform in character, is so variable in colour and markings as to have been called by some entomologists *Coccinella dispar*. One variety of it has scarlet wing-cases, with a black spot on the centre of each, and cream-coloured spots at the inside of the eyes and on each side of the thorax; another variety has a large red patch on each shoulder, a round red spot on each wing-case, and only the margin of the eyes and of the thorax whitish; and while both these varieties have a basis colour of black, they constitute the extremes of a considerable intermediate gradation of varieties.—The seven-pointed species is nearly 3 lines broad, upwards of $3\frac{1}{2}$ long, and pretty uniform in appearance. It is hemispherical or very convex, and black; its wing-cases are bright brick red, and have a large black spot in the centre of the base, with three smaller and triangularly arranged dots; at the base of the head are two cream-coloured dots; and at each of the anterior angles of the thorax is a large cream-coloured dot.

COCCOLOBA. See SEASIDE GRAPE.

COCCOON. The envelope of silky or finely hairy material with which many an insect provides itself for protection during its pupa or chrysalis state. It consists, in some cases, wholly of fine threads spun from the insect's own secretions, and, in others, of such threads combined with adjacent extraneous materials. Some cocoons, as those of the weevils, the chrysomelidous beetles, and the gipsy and satin moths, are formed simply of a few threads, spun into an open case-work, through the meshes of which the pupa can be easily seen; and others, as that of the silk-worm, are very elaborate in construction, and seem to consist of two distinct portions,—externally a loose, gauze-like covering, and internally a closely-woven and compact oval ball. As the silk-worm works from the outside to the inside of its case, the former is of course first spun; but the whole is formed of a single thread; and this, in some instances, can be unwound to the length of about a thousand feet: Malpighi thinks that six distinct layers of silk can be observed in the cocoon of the silk-worm; and Reaumur suspects the number to be still greater.

COCCULUS. A genus of tropical, evergreen, climbing plants, of the moonseed tribe. Twelve species were introduced to Britain from India, between 1790 and 1820; and about forty other species have been scientifically described. All the introduced species are ornaments of the hot-

house; they range in usual height from 6 to 25 feet; and all have oblong-ovate or partially cordate leaves, and whitish-green or greenish-yellow flowers. Two of the introduced species, *C. palmatus* and *C. Plukenetii*, are medicinal; the former of these yields the calumba-root of the British pharmacopeias; and some one of the un-introduced species, probably *C. tuberosus*, yields the large poisonous seed, called *Cocculus Indicus*, commonly sold in drug shops, and somewhat extensively used in some large manufactories of malt liquor. See the articles CALUMBA and ALE. A peculiar, bitter, poisonous principle, now pretty well known under the name of picrotoxia or picrotoxine, is obtained from *cocculus indicus*.

COCCUS. A genus of insects of the order of *heteroptera*, family *gallinsecta*. Generic character: antennæ filiform, of 10 or 11 articulations in both sexes, shorter than the body; rostrum pectorale, conspicuous only in the females; males with two large incumbent wings; females apterous, subtomentose, fixed, and becoming gall-shaped or shield-shaped after impregnation.

These little insects are remarkable for many peculiarities in their habits and conformation. The males are elongated in their form, have long, large wings, and are destitute of any obvious means of suction; the females, on the contrary, are of a rounded or oval form, have no wings, but possess a beak or sucker, attached to the breast, by which they fix themselves to the plants on which they live, and through which they draw their nourishment. At a certain period of their life, the females attach themselves to the plant or tree which they inhabit, and remain thereon immoveable during the rest of their existence. In this situation, they are impregnated by the male; after which, their body increases considerably, in many species losing its original form, and assuming that of a gall, and, after depositing the eggs, drying up, and forming a habitation for the young. This change of form is not, however, constant to all the species, which has given rise to a division of the genus into two sections:—those which assume a gall shape, in which the rings of the abdomen are totally obliterated, are called *kermes* by some authors; and those which retain the distinct sections of the abdomen, notwithstanding the great enlargement of the body, are called true cocci, or *cochineal*. They are impregnated in the spring, after having passed the winter fixed to plants, particularly in the bifurcations, and under the small branches. Towards the commencement of summer, they have acquired their greatest size, and resemble a little convex mass, without the least appearance of head or feet, or other organs. Many species are covered with a sort of cottony down. Each female produces thousands of eggs, which are expelled by a small aperture at the extremity of the body. As soon as they are produced, they pass immediately under the parent insect, which

becomes their covering and guard; by degrees, her body dries up, and the two membranes flatten, and form a sort of shell, under which the eggs, and subsequently the young ones, are found coccated. Soon after the death of the mother, the young insects leave their hiding-place, and seek their nourishment on the leaves, the juices of which they suck through the inflected rostrum, placed beneath their breast.—But it is with a view to their importance as an article of commerce, arising from their use in the arts, that the insects of this genus are particularly interesting. When it is considered that the most brilliant dyes and the most beautiful pigments, as well as the basis of the most useful kinds of cement, are their product, it will be acknowledged, that to none of the insect tribe, except, perhaps, to the bee and the gall insect, are we more indebted than to these singular and apparently insignificant little beings. *Kermes*, the scarlet grain of Poland, *cochineal*, *lac-lake*, *lac-dye*, and all the modifications of *gum-lac*, are either the perfect insects dried, or the secretions which they form.

The first mentioned substance is the *Coccus ilicis*. It is found in great abundance upon a species of evergreen oak, *Quercus coccifera*, which grows in many parts of Europe, and has been the basis of a crimson dye from the earliest ages of the arts. It was known to the Phœnicians before the time of Moses; the Greeks used it under the name of *κεκκοι*, and the Arabians under that of *kermes*. From the Greek and Arabian terms, and from the Latin name *vermiculatum*, given to it when it was known to be the product of a worm, have been derived the Latin *coccineus*, the French *cramoisis* and *vermeil*, and the English *crimson* and *vermilion*. The early Jews, the Greeks, the Romans, and, until lately, the tapestry-makers of Europe have used it as the most brilliant red dye known. The scarlet grain of Poland, *Coccus Polonicus*, is found on the roots of the *Scleranthus perennis*, which grows in large quantities in the north-east of Europe, and in some parts of England. This, as well as several other species, which afford a similar red dye, have, however, fallen into disuse since the introduction of *cochineal*. This valuable and most important material is the *Coccus cacti*, a native of Mexico, and an inhabitant of a species of cactus, called *nopal*, which was long thought to be the *Cactus cochiniifer*, but which Humboldt considers a distinct species. The trees which produce the *cochineal* are cultivated for this purpose in immense numbers; and the operation of collecting the insects, which is exceedingly tedious, is performed by the women, who brush them off with the tail of a squirrel or stag. The insects are killed by being thrown into boiling water, placed in ovens, or dried in the sun. Those which are killed by the latter method fetch a higher price, from the white powder, covering the insect, being still retained, and

thus preventing, in a great measure, the adulteration of the article. The quantity annually exported from South America is immense; the export value being not less than £500,000. In the East Indies, a very inferior kind has been reared, which produces a coarse scarlet dye. Hayti and Brazil have tried to encourage the propagation of this insect.

Lac is a secretion from a species of coccus inhabiting India, where it is found in astonishing abundance. In its native state, not yet separated from the twig on which it has been deposited, it is called *stick-lac*; when separated, powdered, and the colouring matter washed from it, it is denominated *seed-lac*; *lump-lac* when melted into cakes, and *shell-lac* when purified and formed into thin *laminæ*. *Lac-lake* is the colouring matter of *stick-lac* precipitated from an alkaline lixivium, by means of alum.

COCCYGRIA. The wild olive, Venetian sumach, or *Rhus cotinus*. See SUMACH.

COCHINEAL. See COCCUS.

COCHLEARIA. See SCURVY-GRASS.

COCHLOSPERMUM. Two species of lofty, evergreen, ornamental, tropical trees, of the order *ternstroemiaceæ*. They were formerly comprised in the genus *bombax*, but were constituted a separate genus by Kunth. They are natives of respectively India and Mexico; and, when mature, they have an average height of about 60 feet. See the article BOMBAX.

COCK. The well-known chieftain of the poultry-yard, and rural announcer of the passage of time; whose shrill clarion, heard in the still watches of the night, inspires the invalid with cheering hopes of the coming dawn, and informs the way-worn traveller of his approach to the habitations of his kind; the appropriate emblem of vigilance, virility, warlike daring and gallantry: domesticated, but not subdued, he marches at the head of his train of wives and offspring, with a port of proud defiance, not less ready to punish aggression against his dependents than to assert his superiority upon the challenge of any rival. At what time this valuable species of pheasant was brought under the immediate control of man, it is now impossible to determine; but, as the forests of many parts of India still abound with several varieties of the cock in the wild or natural condition, it is quite reasonable to conclude that the race was first domesticated in the eastern countries, and gradually extended thence to the rest of the world. It is stated that the cock was first introduced into Europe from Persia; and Aristophanes speaks of it as the "Persian bird." Nevertheless, it has been so long established throughout the western regions, as to render it impossible to trace its progress from its native wilds.

The cock has his head surmounted by a notched, crimson, fleshy substance, called *comb*: two pendulous fleshy bodies of the same colour, termed *wattles*, hang under his throat. The hen has also

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a similar, but not so large nor so vividly coloured excrescence on her head. The cock is provided with a sharp horn or spur on the outside of his tarsus, with which he inflicts severe wounds; the hen, instead of a spur, has a mere knot or tubercle. There is, in both sexes, below the ear, an oblong spot, the anterior edge of which is reddish, and the remainder white. The feathers arise, in pairs, from each sheath, touching by their points within the skin, but diverging in their course outwards. On the neck, they are long, narrow, and floating; on the rump, they are of the same form, but drooping laterally over the extremity of the wings, which are quite short, and terminate at the origin of the tail, the plumes of which are vertical. In the centre of the cock's tail are two long feathers, which fall backwards in a graceful arch, and add great beauty to the whole aspect of the fowl. It is in vain to offer any description of the colour of the plumage, as it is infinitely varied, being in some breeds of the greatest richness and elegance, and in others of the simplest and plainest hue. Except in the pure white breeds, the plumage of the cock is always more splendid than that of the hen. We cannot contemplate the cock, when in good health and full plumage, without being struck with his apparent consciousness of personal beauty and courage. His movements and gestures seem all to be influenced by such feelings, and his stately march and frequent triumphant crowing express confidence in his strength and bravery. The salacity of the cock is excessive, and one is known to be quite sufficient for the fecundation of 10 or 15 hens. His sexual powers are matured when he is about six months old, and his full vigour lasts for about three years, varying in earliness of maturity and duration with his size and the climate. The hen is ready to commence laying after she has moulted or changed her plumage, and is not at the trouble of making a regular nest. A simple hole, scratched in the ground, in some retired place, serves her purpose, and she generally lays from 12 to 15 eggs before she begins to sit upon them for the purpose of hatching. Having thus taken possession of her nest, she becomes a model of enduring patience, remaining fixed in her place until the urgency of hunger forces her to go in search of food. A short time suffices; she runs eagerly about in quest of sustenance, and soon resumes her charge. Her eggs are diligently turned and shifted from the centre to the edge of the nest, so that each may receive a due degree of genial warmth, and it is not until about 21 days have elapsed that the incubation is completed. The strongest of the progeny then begin to chip the shell with the bill, and are successively enabled to burst their brittle prisons. She continues upon the nest till the whole are hatched and dry, and then leads them forth in search of food. The hen, except when accompanied by a young brood, is always timid, and ready to fly

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from disturbance; but when she is engaged in discharging the duties of maternity, her whole nature is changed. She fiercely and vigorously attacks all aggressors, watches over the safety of her young with the utmost jealousy, neglects the demands of her own appetite to divide the food she may obtain among her nurslings, and labours with untiring diligence to provide them sufficient sustenance. The limits within which we are restricted forbid the attempt to give a complete history of this valuable species, which is, in every point of view, interesting. To detail all that would be necessary to illustrate it, as an object of natural history and domestic economy,—the modes of breeding, rearing, preparing for the table, &c., would require a small volume. Fortunately, almost every one, who will employ his own observation, may readily arrive at such knowledge.

COCKCHAFFER. A species of coleopterous insect, belonging to the genus *melolontha* of Fabricius, remarkable for the length of its life, in the worm or larve state, as well as for the injury it does to vegetation, after it has attained its perfect condition. By Linnaeus, this species, which is also known by the trivial names of *may-bug*, *dorr-beetle*, &c., was placed in the genus *scarabæus*, or beetle; and it is true, that the *melolontha* have the general aspect, conformation and habits of the beetles. They differ from them, however, in having the body less depressed, swelling out above and below into a sort of hump. The head is engaged in the corselet, which is slightly narrowed in front, and most commonly attached to the elytra behind. The antennæ, which are foliated in a mass, are composed of 10 joints, the last of which terminates the mass like a plume, which the insect displays at will, sometimes to the number of seven plates, larger and more perfectly developed in the males than females. The bodies of *melolontha* are very often velvet-like, and covered with hairs and imbricated scales, differently coloured, like the butterflies. Some species are very highly adorned in this way, and present combinations of brilliant and beautiful colours.

The *may-bug* (*Melolontha vulgaris*) is hatched from an egg which the parent deposits in a hole, about six inches deep, which she digs for the purpose. Her eggs are oblong, of a bright yellow colour, and are placed regularly side by side, though not included in any common envelope. At the end of about three months, the insects come out of the eggs as small grubs or maggots, and feed upon the roots of vegetables in the vicinity with great voracity. As they increase in size and strength, they become able to make their way with ease under ground, and continue their ravages upon the roots of plants. When the worm has attained its greatest size, it is an inch and a half long by more than half an inch thick, perfectly white, with a red head, having a semi-circular lip, and a strong pair of jaws, with

which it cuts the roots, for the purpose of sucking out their fluids. It has two antennæ, but is destitute of eyes. The subterranean existence of these animals is extended to four years, and, as their food is not accessible during the cold season, they bury themselves sufficiently deep in the soil to be safe from the frost, and pass the winter in a state of torpidity. When the spring restores them to animation and activity, they revisit the upper stratum of the ground, having, at each annual awakening, undergone a change of skin.—At the end of the third year, they have acquired their full growth as larvae; they then cease eating, and void the residue of their food, preparatory to the change or metamorphosis which they are about to undergo. If opened at this period, their strongly muscular integument is found to be completely filled with a mass of white, oily matter, resembling cream, apparently destined as a reserve for the alimentation of the insect during the period of its remaining in the form of a nymph, which is scarcely less than six months. To undergo their final change, these larvae bore into the earth to the depth of two feet or more, where they form a rounded cavity, the sides of which are smoothed and consolidated by the application of a fluid disgorged from their mouths. The larve being thus secured, it soon begins to contract in length, swells, and bursts its skin, coming therefrom as a soft, whitish nymph, having all the members shrunk and folded, uniformly arranged in the same manner, exhibiting the rudiments of elytra, antennæ, &c. The insect then gradually acquires consistence and colour, becoming of a brownish hue. This state continues about three months, by the end of which time, the insect disengages its wings, limbs, and antennæ, and assumes its rank as a perfect coleopterous insect. It is in the month of February that the larve changes to nymph. During the months of March and April, it approaches the surface of the earth, and about the beginning of May, escapes from its grovelling mode of life to soar through the air, disporting in sunshine and shade. From this circumstance, the German trivial name of *Maikaefer*, and the English *may-bug* or *beetle*, have been given. The term *cockchaffer*, applied to the common species, is evidently made up from the German.

Cockchaffers, in their perfect state, pass the greater part of the day in a state of slumber or quietude, on the leaves of the trees which they feed on, unless disturbed by the too great heat of the sun, which arouses them to fly to the shade. At eventide, the whole of this drowsy population take wing, for the sake of procuring food. Their flight is loud, humming, and generally with the wind; and so little is the insect capable of directing its course, that it strikes violently against every object in the way. This peculiarity has given origin, in France, to a proverbial expression, applied to a thoughtless, blundering person, who is said to be "as stupid as a may-bug." The

generative act of these insects has some peculiarities. The male, which is generally smaller than the female, and always cognizable by the greater size of his foliated *antennæ*, previous to this operation, is very active. As soon, however, as this object is accomplished, he seems to fall into a state of faintness and lethargy, and the female, in flying from place to place, carries him with her, hanging in a helpless, inverted position, with his back downwards, and his feet in the air. The male organs are quite singular, being formed in such a manner that the organ conveying the fecundating fluid is introduced by the aid of two elongated horns, which, by their approximation, form a sort of stiff point. These two pieces lie over another, within which are muscles that, at the proper moment, contract, and thus dilate the sheath, which may be compared to a surgical dilator. To this expansion of the sheath the adherence of the sexes during the act of generation is owing. The males perish as soon as they have fulfilled this great object of their being, as they thenceforth cease to eat. The fecundated female forsakes the trees for the earth, into which, with her claws, she bores a hole six or eight inches deep, in which she places from 50 to 80 eggs. This completes the circle of her actions, and she soon after dies; though it has been said, without any foundation in observation or analogy, that the females, after laying their eggs, resume their former habits, and live among the trees.

COCKROACH. A genus of insects belonging to the orthopterous or straight-winged order, characterized by an oval, elongated, depressed body, which is smooth on its superior surface. The head is inclined, short, and concealed under the corselet; the *antennæ* are long, bristly, formed of numerous pieces, and inserted in a groove within the eyes. The corselet is scutiform, covering the head and origin of the *elytra*; the abdomen is terminated by two conical appendages. The legs are beset with little spines; the feet are long and compressed; the *tarsi* have five joints. They have a longitudinal crop or craw; the gizzard, or muscular stomach, is internally provided with strong hooked teeth: from 8 to 10 *cæca* are found about the pylorus.

These insects are among the most disagreeable of the annoyances to which the dwellings of man are subject, and, where their multiplication is permitted, the ravages they commit are extensive and vexatious. They are all nocturnal, and exceedingly agile; their flattened bodies allow them to hide, with ease, in every crevice, whence they sally forth in hordes during the night, to devour every sort of provision which is not secured from their voracity. Like all other depredators, they are thrown into confusion and put to flight by the presence of light, whence they were, in ancient times, appropriately called *lucifugæ*, or *light-shunners*. Their destructiveness is not confined to articles of provision for the table;

silk, woollen, and even cotton cloths are devoured, or rendered useless by being gnawed through. When a cockroach takes refuge or seeks concealment upon any person, he will inflict a smart bite, if particularly hurt or alarmed. If to a quantity of meal about one-third of white or red lead is added, and the mixture is moistened with molasses, so as to make it moderately adhesive, the cockroaches will greedily devour it. The repetition of this poisoned food for a few nights is generally sufficient to reduce their numbers to a very few, even in the most infected houses, and will eventually cause the destruction of the whole. They may also be poisoned with preparations of arsenic, sublimate, &c., mixed with sugar or molasses, of which they are very fond. A paste-board or card cover, well balanced upon two pins, and placed upon the edge of a vessel, nearly filled with molasses and water, makes a very good trap. The dish should be so placed, that they can readily mount upon the cover, which revolves on its axis whenever the equilibrium is disturbed, and throws the cockroaches into the fluid.

Cockroaches, like other orthopterous insects, do not undergo a complete metamorphosis: the larvae and nymphs resemble the perfect insect, except that they have merely rudiments of wings. The females lay their eggs successively and singly. The egg has a very singular appearance, being large, cylindric, rounded at both ends, and having a projecting dentated line or keel, throughout its length, on one side. This egg is half as large as the belly of the female, and she carries it for seven or eight days, attached to the posterior part of the abdomen, and, finally, attaches it to some solid body, by means of a gummy fluid.—The species of cockroach at present determined, are about 12 in number. Among these, the *Blatta americana* is the largest of the genus, and grows to be two or three inches long, including the *antennæ*. The *Blatta orientalis*, or common kitchen cockroach, was originally brought from Asia to Europe. This species is fond of warmth, and makes its abode near to the kitchen fireplace, about ovens, stoves, &c.

COCKEREL. A young cock; but the name is provincial.

COCKSCOMB,—botanically *Celosia*. A genus of curious and ornamental, tender, herbaceous plants, of the amaranth tribe. The crested species, *Celosia cristata*, is one of the most splendid of annuals, and deservedly a great favourite with florists, and a conspicuous autumnal ornament of the greenhouse. It is a native of Asia, and was introduced to Britain in 1570. It usually attains a height of about two feet; and it carries a broad, crested, and most brilliant head of compactly amassed little flowers. "Of this," says Miller, "there are many varieties, which differ in their form, magnitude, and colours, but, as they vary from seeds, are not enumerated as distinct species. I have raised great varieties of these from seeds which came from China, but have generally

found them alter in a few years, notwithstanding great care has been taken in the saving their seeds. The principal colours of their heads are red, purple, yellow, and white; but I have had some whose heads were divided like a plume of feathers, which were of a beautiful scarlet colour; but these in a few years degenerated." All the principal varieties of *Celosia cristata*, as at present understood, however, have either a buff-yellow or more or less of a dark red colour, and are classifiable into the florescent, the compact, the dwarf, and the tall. But seven other annual, ornamental species are in cultivation,—all rather more tender than *Celosia cristata*, but more or less resembling it in character;—the silvery-spiked, *C. argentea*, a foot high, and flesh-coloured; the tufted, *C. comosa*, a foot high, and pink-coloured; the knotted-flowered, *C. nodiflora*, two feet high, and green-coloured; the camp, *C. castrensis*, two feet high, and purple-coloured; Morison's, *C. Monsonia*, a yard high, and white-coloured; the drooping, *C. cernua*, a yard high, and purple-coloured; and the scarlet, *C. coccinea*, five feet high, and crimson-coloured. Some other annual species, and two evergreen small shrubby species, may be seen in some rare collections; but they possess very little interest; and eight or nine other known species have not as yet been introduced. Very fine or even moderately good flowering plants of the crested species, or of the species akin to it, can be obtained only by means of very rich soil, very stimulating manure, several repottings, and nice care in watering and in the other details of culture.—Two plants of widely different character from each other and from the *Celosia* genus, also bear the name of cockscomb; the one a yellow-flowered annual weed of British meadows and pastures, *Rhinanthus Crista-galli*; and the other one of the most magnificent, scarlet-flowered, evergreen, arborescent ornaments of the hothouse, *Erythrina Crista-galli*.

COCKSFOOT,—botanically *Echinochloa crus-galli*. An indigenous annual grass, of the prickly-grass genus. It grows in moist fields, and attains a height of about 20 inches. Cocksfoot is also the popular name of all the grasses of the *dactylis* genus. See the article **DACTYLIS**.

COCKSPUR,—botanically *Crataegus Crus-galli*. A species of hawthorn, sometimes called Cockspur hawthorn and Virginian Cockspur. It was introduced to Britain from North America, toward the close of the 17th century. Its stem is erect, and attains a height of about 20 feet; its branches are smooth, and of a brownish colour, thinly maculated with small white spots; its spines are shaped somewhat like the spurs of cocks, and give to it the name of Cockspur; its leaves are oval, angular, serrated, smooth, bent backward, and about 4 inches long and 3½ broad; its flowers are produced in very long umbels, and make a noble show in May and June; and its fruit are large, and have a bright red colour, and, together with the large, turgid, bold-looking leaf-buds,

give the plant an imposing appearance in winter. Four very distinct varieties of it, all about the same height as the normal plant, are in cultivation,—the shining, *C. C. splendens*,—the linear, *C. C. linearis*,—the willow-leaved, *C. C. salicifolia*,—and the pyracant-leaved, *C. C. pyracanthifolia*.

COCOA. See **CACAO** and **CHOCOLATE**.

COCOA-NUT-TREE,—botanically *Cocos*. A genus of tropical trees, of the palm tribe. Eleven species are known to botanists; and three of these, the common, the plumose, and the flexuous, have been introduced to the hothouses of Britain. The common species, *Cocos nucifera*, is one of the best known and most useful of all the palms. Its stem is smooth, bare, and marked with circular rings; and, though less than a foot in diameter, soars to the height of 70 or 80 feet; its pinnated leaves form a noble crown upon its summit, in the ordinary manner of palms,—and each is about 18 feet long, and from 3 to 4 feet broad; its leaflets are long, narrow, and sword-shaped, and spring from each side of the centre nerve of the leaves; its flowers grow in clusters,—and each cluster is enclosed in a long spatha or sheath; and its fruit hangs clustering among the leaves, and is at first tender and whitish, but gradually hardens and embrowns,—and when ripe it consists of a smooth, greyish-brown, leathery, fibrous husk about an inch thick, and a very hard-shelled spheroidal nut, with a hollow kernel, and a central milky fluid. A tree possesses at all seasons very great beauty, and usually exhibits, on any one day of the year, the bud, the flower, the drupa, the miniature nut and the perfectly ripe fruit all simultaneously upon its boughs.

The cocoa-nut-tree is extensively diffused, within the tropics, both as a natural production and as an object of cultivation; and in India, in particular, it is more abundant than the olive in Spain, or the willow in Holland, and is esteemed the most valuable of all trees. In 1813, the number of cocoa-nut-trees cultivated in Ceylon, along a line of coast of about 184 miles, was ten millions; and in the following years, their number was increased. Two or three crops of nuts are borne every year by each healthy tree. Excellent houses, warm, comfortable, and substantial enough to resist the strongest monsoon, are sometimes made wholly of the cocoa-nut plant,—the supporters and rafters of its timber, the walls, doors, windows and roof of its leaves, and the fastenings of the fibre of its nuts. Elephants are fed on its leaves; and the Cingalese washer-women use its ashes instead of soap. Sugar, palm-wine, and vinegar are made from a liquor which flows copiously from any incision in the flower-sheath. The natives of many tropical countries are more palmivorous than granivorous, and obtain so large a proportion of their food from the juices and kernel of the cocoa-nut, that a man who possesses twelve cocoa-nut-trees and two jack-trees, finds all his natural wants supplied, and has no incentive to labour. A facile preparation of the fibres

of the nut is used for stuffing saddles, cushions, and mattresses, for sowing together the planks of boats and the pieces of architecture, and for making ropes of even greater strength than ordinary European cables. The kernel of the nut has a taste and consistence somewhat like an almond, and is sometimes eaten with meat and fish in lieu of bread. The juice of the nut is a most cooling, grateful, and nutritious beverage; and is frequently and in various ways used as a substitute for milk. The fixed oil, abundantly obtained from the nut by expression, is used, in lamps, in pharmaceutical preparations, and in other ways, as a substitute for olive oil; and, for some time past, it has been extensively employed in Britain in the making of oil-cloth, the making of soap, the operations of glass-blowing, and especially the manufacture of candles. The shells of the nuts are made into beads, drinking-vessels, sugar-basins, and various ornate utensils; and when converted into charcoal, and mixed with lime, they are used in the East to colour the walls of houses. "The natives of India recommend a decoction of the roots of the cocoa-tree, mixed with ginger, as an excellent febrifuge. The juice expressed from young branches, combined with oil, is said to be a useful application to piles. In chronic inflammation of the urinary organs, they recommend a mixture of the expressed juice of the flower of the cocoa-tree and sugar. The oil is said to be useful if applied to ulcers or pustules on the head. Mixed with salt, and drunk to the quantity of eight ounces, it is said to expel worms from the intestines. Particular virtues have been attributed to cups made of the shell of the nut. They have been supposed to give an antiapoplectic quality to intoxicating liquors. Many other virtues are ascribed to different parts of the tree, of which it is not necessary here to take notice."—[Rhind's Vegetable Kingdom.]—See the article COIR.

COCOA-ROOT. See ARUM.

COCOMILLA. An ornamental species of plum-tree, introduced to Britain from Calabria in 1824. It attains the same height, and has the same colour of flower, as the common English plum.

COCOS. See COCOA-NUT-TREE.

CODLING. See APPLE-TREE.

CŒLOGYNE. A genus of splendidly ornamental epiphytous plants, of the orchis tribe. Ten species were introduced to Britain, between 1822 and 1836, principally from India, Nepal, and China. One of these, the eyeletted, *C. ocellata*, a native of Nepal, may be selected as a specimen of the whole. Its pseudo-bulbs are ovate, acuminate, and wrinkled,—at first green, and afterwards purple,—and, while young, partially sheathed by large brown scales; its leaves are two in number, a span in length, ligulate, one-nerved, and somewhat leathery; its flower-stem rises from between the leaves, and is clothed with long sheathing scales; its raceme grows erect, or droops only towards the summit, is

shorter than the leaves, and has from four to six large flowers; its sepals are spreading, oblong, obtuse, and pure white; its petals are narrower than the sepals, and are also spreading; and its flower, viewed collectively, is a brilliant combination of white, yellow, and orange; and, viewed in detail, has been described as follows:—"Lip applied to the column, oblong, three-lobed; lateral lobes obtuse, erect, and incurved; the middle lobe ovate-cordate, obtuse; the colour is white, tinged with yellow, and veined with orange; within each lateral lobe is a large ocellated orange spot, and there are three smaller ones at the base of the terminal lobe. The disc of the lip has three longitudinal, waved lamellæ. Column long, slender, white, the margin and disc in front yellow. Anther-case green, surrounded by the obscurely three-lobed margin of the top of the column. Pollen-masses yellow."

CŒSIUS. See DEWBERRY.

COFFEE. The seed of an evergreen shrub, which is cultivated in hot climates, and is chiefly imported from Arabia and the East and West Indies. This shrub, *Coffea Arabica*, belongs to the madder family, is from 15 to 20 feet in height, and has, for 150 years past, been occasionally grown in British hothouses. The leaves are 4 or 5 inches long, and 2 broad, smooth, green, glossy on the upper surface; and the flowers, which grow in bunches at the base of the leaves, are white and sweet-scented. The berries and fruit are somewhat of an oval shape, about the size of a cherry, and of a dark-red colour when ripe. Each of these contains two cells, and each cell a single seed, which is the coffee as we see it before it undergoes the process of roasting.

Coffee is an article of but recent introduction. To the Greeks and Romans it was wholly unknown. Its use appears to have originated in Ethiopia; and it is stated to have been first introduced into Constantinople in 1554, from whence it was gradually adopted in the western parts of Europe. In 1652, Daniel Edwards, a Turkey merchant, brought home with him a Greek servant, whose name was Pasqua, and who understood the methods of roasting coffee, and making it into a beverage. This man was the first who publicly sold coffee in England, and kept a house for that purpose in George yard, Lombard-street. At Paris, coffee was nearly unknown, until the arrival of the Turkish ambassador Solomon Aga, in 1669; about three years after which the first coffee-house is said to have been established in that city. The coffee-shrub was originally planted in Jamaica in 1732.

Great attention is paid to the culture of coffee in Arabia. The trees are raised from seed sown in nurseries, and afterwards planted out in moist and shady situations, on sloping grounds, or at the foot of mountains. Care is taken to conduct little rills of water to the roots of the trees, which, at certain seasons, require to be constantly surrounded with moisture. As soon as the fruit is

nearly ripe, the water is turned off, lest the fruit should be rendered too succulent. In places much exposed to the south, the trees are planted in rows, and are shaded from the otherwise too intense heat of the sun, by a branching kind of poplar-tree. When the fruit has attained its maturity, cloths are placed under the trees, and upon these the labourers shake it down. They afterwards spread the berries on mats, and expose them to the sun to dry. The husk is then broken off by large and heavy rollers of wood or iron. When the coffee has been thus cleared of its husk, it is again dried in the sun, and, lastly, winnowed with a large fan, for the purpose of clearing it from the pieces of husks with which it is intermingled. A pound of coffee is generally more than the produce of one tree; but a tree in great vigour will produce three or four pounds.—The best coffee is imported from Mocha, on the Red sea. This kind, which is denominated *Mocha* and *Turkey coffee*, is of a better quality than any which the European colonists are able to raise, owing, as it is supposed, to the difference of climate and soil in which it grows. It is packed in large bales, each containing a number of smaller bales, and, when good, appears fresh, and of a greenish-olive colour. The coffee next in esteem to this is raised in Java and the East Indies; and that of lowest price, in the West Indies and Brazil. When stowed in ships, with rum, pepper, or other articles, it is said that coffee contracts a rank and unpleasant flavour; and this has been assigned as a reason of the inferiority of that which is imported from the European plantations.—The quantity of coffee annually supplied by Arabia is supposed to be upwards of 14,000,000 of pounds. Before the commencement of the French revolution, the island of St. Domingo alone exported more than 70,000,000 of pounds per annum; and, at the present day, such is the fertility of this island, that sufficient coffee is raised to reduce the price greatly in all parts of the civilized world. Almost all the Mohammedans drink coffee at least twice a-day, very hot, and without sugar.

The excellence of coffee depends, in a great measure, on the skill and attention exercised in roasting it. If it be too little roasted, it is devoid of flavour, and if too much, it becomes acrid, and has a disagreeable burnt taste. In Europe, it is usually roasted in a cylindrical tin box, perforated with numerous holes, and fixed upon a spit, which runs lengthwise through the centre, and is turned by a jack, or by the hand. Coffee is used in the form either of an infusion or decoction, of which the former is decidedly preferable, both as regards flavour and strength. Coffee, as very commonly prepared by persons unacquainted with its nature, is a decoction, and is boiled for some time, under a mistaken notion that the strength is not extracted unless it be boiled. But the fact is just the reverse. The fine aromatic oil, which produces the flavour and

strength of coffee, is dispelled and lost by boiling, and a mucilage is extracted at the same time, which also tends to make it flat and weak. The best modes are, to pour boiling water through the coffee in a biggin or strainer, which is found to extract nearly all the strength; or to pour boiling water upon it, and set it upon the fire, not to exceed 10 minutes. Prepared in either way, it is fine and strong. As a medicine, strong coffee is a powerful stimulant and cordial, and, in paroxysms of the asthma, is one of the best remedies; but it should be very strong, and made with almost as much coffee as water. In faintness or exhaustion from labour and fatigue, and from sickness, coffee is one of the most cordial and delicious restoratives. There are coffee-machines, in which the water is boiled, and the steam penetrates the coffee, and extracts, to a great degree, the fine aroma. Immediately after, the boiling water is poured over it. Thus the best coffee is made. As we have already said, in Europe, coffee is generally roasted in a cylinder; in Asia, however, open pans or tin plates are used, and, if the time allows, a boy is employed, who picks out every bean, when it has reached the right degree of brownness. The same is done by some French people. The second difference in the Asiatic way of preparing coffee is, that they pound the beans, and do not grind them, much preferring the former mode. In Marseilles, we have seen coffee likewise pounded. Whether this is really preferable, we do not venture to decide; but experience has taught us that the Asiatic coffee is, on the whole, much better than the European. The difference is probably owing to the different way of roasting. The Turks and Arabs boil the coffee, it is true, but they boil each cup by itself, and only for a moment, so that the effect is, in fact, much the same as that of infusion, and not like that of decoction. They do not separate the coffee itself from the infusion, but leave the whole in the cup. It improves the beverage very much to roast and grind the coffee just before it is used.

COFFEE-TREE (KENTUCKY). See BONDRE (HARDY).

COFFIN-BONE. The proper or characteristic bone of the horse's foot. It is wholly enclosed in the hoof, fills the fore-part of it, and lies closely within it as if within a coffin. It is round above, where it receives the little pastern; but becomes broader and thinner towards the bottom. It has an open, porous texture, somewhat like a piece of loaf-sugar, and is easily pierced; and, in consequence of this peculiar texture, it frequently and facilely receives injuries from small sharp substances on the streets or roads, but just as facilely recovers from the hurtful effects of contusions and wounds.

COGWOOD-TREE,—botanically *Laurus chloroxylon*. An evergreen, tropical, timber-tree, of the laurel genus. It grows wild in the West Indies; and when full-grown, has an average

height of about 60 feet. Dwarf specimens of it, in a living state, began to be seen in British hot-houses about twenty years before the close of last century.

COHESION. That force which preserves in union particles of a similar kind. Its action is seen in a solid mass of matter, the parts of which cohere with a certain force which resists any mechanical action that would tend to separate them. In different bodies, it is exerted with different degrees of strength, and is measured by the force necessary to pull them asunder. According to Sickengen, the relative cohesive strength of the metals is as follows:—

Gold,	150,955
Silver,	190,771
Platina,	262,381
Copper,	304,696
Soft iron,	362,927
Hard iron,	359,880

Cohesion in liquids is very much weaker, the parts being disjoined with much more facility; and, in substances existing in the aerial form, it is entirely overcome, the particles, instead of attracting, repelling each other.—Cohesion in bodies is weakened or overcome by two general causes—by the repulsion communicated by caloric, or by the attraction which may be exerted by the particles of one body on those of another.—Caloric communicated to a solid body separates its particles to greater distances, as is evident from the enlargement of volume which it produces. By thus increasing the distances, the force with which the attraction of aggregation or cohesion is exerted is diminished; if the heat be carried to a sufficient extent, the cohesion is so far weakened, that the body passes into the liquid form; and, if carried still farther, the attractive force is entirely overcome, repulsion is established between the particles, and the body passes into the aëriform state.—The same effects are produced by the exertion of that attraction which unites the particles of one body with those of another. If a liquid be poured on a solid, it often happens that their mutual attraction is sufficiently powerful to overcome the cohesion of the solid: its particles are consequently disunited, to combine with those of the liquid, and it entirely disappears. This forms the chemical process of *solution*. A similar effect is sometimes produced by the chemical action of an aëriform body.—When these powers, whether of heat or of chemical attraction, are withdrawn, cohesion resumes its force, but with results which are different, according to the circumstances under which this happens.—When the attraction of aggregation is suddenly and forcibly exerted, the particles are united, in general, indiscriminately, and according to no regular law. If a body, which has been melted, is suddenly cooled to a sufficient extent, it becomes solid, and forms a mass of no regular structure or figure; or, if its cohesion has been suspended by the chemical attrac-

tion exerted by another body towards it, and if this attraction suddenly cease to operate, the force of cohesion is resumed, and the solid substance appears in the form of a powder. This latter case forms the chemical operation denominated *precipitation*.—But, if the force of cohesion is exerted more slowly, the particles are united, not indiscriminately, but usually with regularity, so as to form masses of regular structure and figure, bounded by plane surfaces and determinate angles. This forms the operation of *crystallization*; and such masses are denominated *crystals*.

COIR. The cordage manufactured from the filamentous fibres of the husk of the cocoa-nut. It has an astonishing strength and durability; it requires no tar or other application to protect it from injury; and it is so elastic that it will stretch fifty per cent. of its entire length without breaking. It began, a number of years ago, to be used for rigging and cables in the British navy; and it might very advantageously be used for various purposes in the farmery. The manufacture of it, while the Dutch possessed Ceylon, was a monopoly, and was supposed to be conducted to the amount of three millions of pounds weight a-year; but both the manufacture and the export of it were thrown open by the British.

COIX. A genus of curious tropical grasses. See **JOB'S TEARS**.

COKE. Most kinds of coal contain sulphur, which would be so prejudicial to iron as to prohibit the use of that material for the purpose of smelting the ore. Wood, on the contrary, contains nothing that can injure iron; but, in its ordinary state, its humidity prevents rapid combustion, and it will not yield sufficient heat until it has been converted into charcoal; and then it is the very best fuel that can be used, but is expensive on account of the labour of preparing it, and its very rapid combustion. It is believed that Swedish iron—which has for many years preserved a higher character for strength, toughness, and ductility than the metal of any other country—owes its perfection to its being manufactured by the charcoal of pine wood; and those varieties of iron denominated *charcoal iron*, from a similar process of production, are more sought after for good work and command higher prices than other iron. Next to the charcoal of wood, mineral charcoal, or the cinders of bituminous coal, called *coke*, is the best fuel for reducing iron ore, or melting iron, and this fuel is alone used in Britain, where wood is scarce. Coke is pit-coal broken into small pieces, ignited with free access of air, and permitted to burn until it ceases to give out flame or smoke, and the whole mass becomes red hot. It is then shut up so that the air cannot reach it, when further combustion becomes suspended, and in this state, after being permitted to cool, it is ready for use. The making of coke is carried on in a small way, by ovens built for the purpose,

and which usually contain thirty-six bushels of coal. A door serves the common purpose of introducing the coal and admitting air, and a chimney is built to carry off smoke and promote a circulation of air through the oven while the coal is burning; and as soon as the burning has been carried to a sufficient extent, the door and chimney are both closed, and luted with moist clay, so that no more air can enter, and in this state the oven is left some hours for cooling, when the coke is drawn out by a large wide iron shovel called a *peel*, which is supported by a chain from a small swinging crane or gibbet. Water is thrown on the coke after it is discharged, to prevent its rekindling, and it is likewise said to harden and improve it. After the coke is withdrawn, the oven will retain sufficient heat to re-kindle the next charge of coals, which is immediately introduced, and each charge of 36 bushels generally requires 24 hours for its coking, so that the oven may be charged daily and kept at constant work. Coke swells so much in its formation, that 36 bushels of coal will produce from 45 to 48 bushels of coke; and when it is good and well burnt it becomes very hard, has a shining and almost metallic lustre, and is very sonorous. Notwithstanding that coke is better and more economically made in a close oven than in any other way, yet such ovens are too tedious and expensive for large iron works at which the coke is constantly made on the open ground. The coal is piled up in long heaps, and after being ignited and suffered to burn a sufficient time, earth is dug and thrown upon them until the air is thought to be quite excluded, and the heaps are then watered through the earth, and are not opened until the coke becomes quite cold.

—*Millington.*

COLCHICUM. A genus of ornamental, bulbous rooted plants, of the *melanthium* tribe. The autumnal or meadow-saffron species, *C. autumnale*, grows wild in the meadows of many parts of Britain, and is particularly abundant in Suffolk and Essex. Its bulb is solid and egg-shaped, and covered with a brown, membranous skin; its leaves are radical, lanceolate, and about five inches in length and half an inch in extreme breadth,—and they appear in spring, and wither wholly away before the end of summer; and its flowers spring direct from the offsets of the bulb whose leaves have decayed,—they comprise a segmented tubular corolla, of about five inches in length, two-thirds of which are below the ground, and subulate yellow-anther-bearing filaments of half the length of the segments of the corolla,—and they have a pale pinkish lilac colour, and appear in September and October. The bulbs have strongly acrid, narcotic, poisonous properties; and figure among the *materia medica* of the British pharmacopœias. An instance is recorded of their having been accidentally boiled with potatoes, and in consequence poisoning a whole family. So small a quantity as from three

to nine grains of the dried bulbs is a full medicinal dose; so that this drug is vastly too active to be played with by quacks and empirics. The diseases for which it is prescribed are dropsy, humoral asthma, gout, rheumatism, and various disorders of the gall-duct and the nerves. A milky-looking acrid juice exudes from a transversely-cut, fresh bulb; and this, when treated with alcoholic solution of guaiacum, produces a beautiful cœrulean blue colour. A peculiar alkaline principle, variously called *colchicia* and *veratrine*, is obtainable from the bulbs, and seems to comprise all their medicinal and narcotic power; it takes the form of a white powder, and is easily soluble in alcohol; and it consists of 66.75 per cent. of carbon, 19.6 of oxygen, 8.54 of hydrogen, and 5.04 of nitrogen. The other constituents of the bulbs are lignin, inulin, starch, gum, malic acid, fatty matter, and a yellow colouring matter. The petals, the leaves, the seed-vessels, and the seeds all more or less partake of the active principles of the bulbs, and ought, as much as possible, to be kept out of the way of children, and even of cattle. A French veterinary journal relates a case of twelve cows, which were suddenly seized with very alarming symptoms, in consequence of eating the leaves and the seed-vessels, and states that they were restored in the course of two or three days by the use of strong decoctions of linseed.—Six varieties of the autumnal *colchicum* are grown in British gardens as ornaments of the parterre,—the white-flowered, the double-flowered, the striped double-flowered, the variegated-leaved, the purple-striped, and the dark purple; and nine other species, all hardy, and principally purple-flowered, have been introduced from the Crimea, the Levant, Chio, Hungary, and the south of Europe.

COLD. A peculiar sensation excited in animals, when substances at an inferior temperature are applied to their organs of feeling. It is also used to denote a certain principle or power residing in bodies, by the operation of which the sensation is produced. It was long considered doubtful whether this principle ought to be regarded as a distinct condition of matter, or as a mere modification of caloric; though almost all men of science are now disposed to consider it in the latter point of view.

The means, with which we are acquainted, of reducing the temperature of bodies, are much more limited in their effects, than those of increasing it. But many important facts connected with the production of cold have already been discovered; and though we can scarcely expect ever to acquire the same extensive command over the lower, as we already possess over the higher temperatures, we have reason to hope, that since we know the circumstances upon which refrigeration depends, processes of cooling may yet be discovered still more effectual than any that have hitherto been employed. The various methods of producing cold, which are at

present known, may all be referred to rarefaction, evaporation, and liquefaction, induced by chemical action. We shall briefly notice, in order, each of these methods of reducing the temperature of bodies.

If an aerial fluid be suddenly enlarged in volume, by the removal of any mechanical pressure to which it may have been subjected, its temperature is perceptibly diminished. Thus, a thermometer exposed to the stream of air which issues from an air-gun, has its temperature reduced 5 or 6 degrees; and a similar effect is produced when it is enclosed in the receiver of an air-pump, during the process of exhaustion. The diminution of temperature by rarefaction, is well exemplified by the celebrated fountain of Hiero, at the mines of Chemnitz in Hungary, where the air in a large receiver is compressed by a column of water, equal to the weight of about 8 atmospheres. On turning a stop-cock, the air suddenly makes its escape, and during its expansion, deposits the watery vapour which it held in solution, in the form of snow, or covers the inside of the tube through which it rushes, with slender spiculæ of ice. In most cases, however, this method of producing cold is very limited, and scarcely capable of being applied to practical purposes.

Evaporation is of more extensive influence in reducing the temperature of bodies, than rarefaction. Every person must have felt, that when the hand has been dipt in water and then exposed to a current of air, the parts which had been moistened soon became much colder than the parts which had been allowed to remain dry, though the cooling medium is the same. Dr. Cullen appears to have been the first who ascribed the difference of effect to the evaporation of the fluid. He observed, that a thermometer, the bulb of which had been dipt in a fluid, and then exposed to a current of air, always indicated, so long as it remained moistened, a lower temperature than the air itself; and that the reduction of temperature was greatest when the thermometer had been dipt in the most volatile fluids. If the bulb of the instrument be surrounded with a piece of linen well moistened with ether, and afterwards exposed to a free current of air, the temperature is reduced from 50° to near zero. The effect with alcohol is considerably less, and with water it is limited to four or five degrees. Water may, in this manner, be frozen, by pouring a small quantity of it into a slender tube which is surrounded with linen moistened in ether, and then swinging the tube rapidly round the head by means of a string attached to it. When water is made to ooze slowly through porous unglazed earthen vessels, it presents a very extensive surface to the atmosphere, and as it suffers a proportional degree of evaporation, its temperature is kept considerably below that of the air. If one of these porous vessels be allowed to imbibe water for some time, it retains, when the water is poured out of it, a considerable quantity of moisture; and as it now presents both an interval and an external surface to the air, the evaporation is greatly increased. The absorption of caloric for the conversion of the water into vapour is increased in an equal degree, and consequently a greater reduction of temperature is obtained. Accordingly, liquors are very conveniently cooled, by placing the bottles which contain them, in these unglazed earthen vessels, previously well moistened with water. Wet cloths wrapped round bottles produce the same effect. In India, where the conversion of water into ice is the sole employment of many individuals, the water to be frozen is exposed during the night in flat unglazed earthen vessels, which are placed upon the worst conductors that can be procured, such as sugar-canes, dried stems of

maize, &c. The dryness of the air causes a very considerable evaporation, and the consequent reduction of temperature is such, that a thin film of ice is formed towards the morning, though the temperature of the air may have been all the time above the freezing point. The quantity of ice obtained is greater when the weather is warm and dry, than when it is moist, though in the latter case the temperature of the air may have been actually lower.

The third method of producing cold which we proposed to consider, is liquefaction induced by chemical action. The solution of salts in water, by the transition to the fluid state, is always accompanied with a considerable diminution of temperature. When nitre is added to water, at the ordinary temperature of the atmosphere, until the water is saturated, the temperature is reduced 15 or 16 degrees; and a still greater degree of cold is obtained by the solution of muriate of ammonia. But of all the salts, nitrate of ammonia seems to undergo the greatest reduction of temperature during its solution. If it be mixed, in the state of a fine powder, with an equal weight of water, the temperature is reduced from 50° to 4° . As the production of cold, by freezing mixtures, depends partly upon the rapidity with which the substances employed pass into the liquid state, and partly upon the increase of capacity for caloric which is acquired by that transition, it might be expected that a greater reduction of temperature would be obtained, by dissolving salts in acids than in water. Accordingly, by dissolving a pound and a half avoirdupois of Glauber's salts (sulphate of soda) in 12 ounces of nitrous acid, previously diluted with 6 ounces of water, Mr. Walker obtained a diminution of temperature from 50° to -1° ; when sulphuric acid, diluted in the same proportion, was employed, the reduction was from 50° to 5° ; and three parts of the same salt by weight reduced to a fine powder, and dissolved in two parts of muriatic acid, sunk the thermometer from 50° to zero. The reduction of temperature is still greater, when different salts are employed at the same time. Thus, nitrate of ammonia 6 parts, phosphate of soda 9 parts, and diluted nitrous acid 4 parts, all by weight, reduce the temperature of the mixture from 50° to -21° . This is a diminution of 71° , and is the greatest degree of cold that can be procured by a single mixture yet known. Mr. Walker succeeded in freezing mercury, by cooling, in a succession of these mixtures, the ingredients by whose liquefaction the congelation was ultimately to be produced, though the temperature of the air at the commencement of the experiment was 45° .

The degrees of natural cold which occur in the more inhospitable regions of the globe, are far surpassed by the reductions of temperature obtained by artificial means. The greatest cold that has hitherto been observed in the open air, does not exceed -50 ; and probably the extreme range of the inferior temperatures which occur in nature, is but little below that point. The temperature of a particular place on the surface of the earth is determined by a variety of circumstances, some of which are regular in their operation, others accidental. Among the former of these, may be stated, the direct influence of the solar rays, and the latitude; among the latter, the winds, evaporation, and perhaps the evolution or absorption of heat by operations going on in the central regions. Even the causes of temperature which we have denominated regular, are not absolutely so: the heat produced by the

rays of the sun may be effected by spots upon his surface; and the temperature resulting from geographical position may be modified by local peculiarities. Thus the sea limits the range of temperature, by moderating alike the extremes of heat and cold; while large tracts of land are equally favourable to both. The winds have a very powerful influence on the temperature of a place. When the surface of the earth is much heated by the influence of the solar rays, the air immediately above it is rarified, and becoming specifically lighter, ascends into the higher regions of the atmosphere. Its place is quickly occupied by a fresh portion of air rushing in from every side, which, in its turn, being heated and rarified, also ascends. The warm air which has thus ascended, is gradually wafted to colder regions, where it gives out its heat, and moderates the rigour of the climate to which it has been transported. Evaporation is one of the principal sources of natural cold, the conversion of water into vapour being necessarily accompanied with the absorption of much caloric; hence, the agricultural improvement of a country, or whatever tends to facilitate the escape of the water from its surface by any means but evaporation, has a remarkable influence on its temperature. The gradual amelioration of the climate of America, is undoubtedly to be ascribed to this cause, as well as that of Europe.

COLD, in medicine. See CATARRH.

COLD-CHARGE. A charge consisting of vinegar, Armenian bole, and the white of eggs, mixed together to the consistency of a poultice. See the article CHARGE.

COLE, COLSA, or COLZA,—botanically *Brassica campestris oleifera*. A hardy, cultivated, biennial, agricultural plant, of the cabbage and turnip genus. It is frequently confounded with the oleiferous subvariety of rape; but may be readily distinguished from that plant by the greater size of its pods and seeds, by the clearer and lighter yellowness of its flowers, and especially by the roughness or hispidity of its leaves. It is considerably the most oleiferous of the brassicas; it ought always to be cultivated in preference to rape, when oil is the principal object; and it is extensively cultivated as an oil plant in the Netherlands. It is cultivated in nearly the same manner as turnips, but requires a richer soil, and admits of being sown at a later period in the season; it is sometimes sown to be fed off with sheep or cattle, on land which is unsuitable for turnips, or on which they fail; it sometimes occurs with great advantage, in a rotation, immediately before wheat; and in the flat, rich fennishly meadowy tracts of the counties of Lincoln, Cambridge, Huntingdon, and Essex, it is profitably cultivated for the double purpose of early winter feeding and of oil,—the crop being sown between the middle of July and the middle of August, eaten by sheep from the latter part of autumn till the end of January, and matured for

its oil seeds in the following autumn. But in order to its making an amply remunerating return, the land for it must either be newly drained fennish-meadow, or rich and newly broken up pasture, or very fertile corn-land, well-manured with spit-dung.

In the Netherlands, where cole is a prominent and highly esteemed agricultural plant, not only is it grown on rich land, with a profusion of such powerful manures as night-soil and bruised rape-cakes, but it is economized and strengthened by a system of transplanting similar to what is practised with the cabbage and borecole brassicas. Radcliff, in his *Agriculture of East and West Flanders*, states the following as the usual process:—"The seed-bed is sown in August or even to the middle of September. In October, or sooner, the stubble is ploughed over, manured, and ploughed again. The plants are dibbled in the seams of the ploughing—each furrow-slice being twelve inches broad—and are set out at twelve inches distance in the rows. Instead of dibbling upon the second ploughing, they, in many cases, lay the plants at the proper distances across the furrow, and, as the plough goes forward, the roots are covered, and a woman follows to set them a little up, and to give them a firmness in the ground where necessary. Immediately after the frost, and again in the month of April, the intervals are weeded and hand-hoed, and the earth drawn up to the plants, which is the last operation till harvest. The crop is pulled rather green, but ripens in the stack, and is thrashed out without any particular management; but the haulm is burnt for ashes, as a manure, which are found to be so highly valuable beyond all other sorts which have been tried, that they bear a price as three to one above the other kinds; and it is considered that upon clover, a dressing of one-third less of these is amply sufficient." A variety of cole with white-coloured flowers may sometimes be met with; but it is less hardy than the common yellow-flowered variety. The seeds for oil are treated in the same manner as those of rape. See RAPE. The average produce of an acre of good cole is about 30 bushels of seed.—*Museum Rusticum*.—*Knowledge Society's Treatise on Flemish Husbandry*.—*Young's Farmer's Calendar*.—*Society of Gentlemen's Complete Farmer*.—*Radcliff's Agriculture of Flanders*.—*Loudon's Gardener's Magazine*.

COLEA. A small genus of ornamental stove plants, of the trumpet-flower tribe. The yellow-flowered species, *C. floribunda*, inhabits the forests of the east coast of Madagascar; and was brought to flower for the first time in Europe, in 1840. It is a shrub of stately aspect and singular habit; its stem is seven or eight feet high, and perfectly simple; its leaves are pinnated, and have an imposing appearance, and grow only as a sort of crown on the summit of the stem; and its flowers have a bright ochreous-yellow colour, with a very pale border, and grow on the old wood,—from

just above the places whence the leaves of previous years had fallen.

COLEUS. A genus of elegantly-flowering plants, of the labiate order. They are easily distinguished from all other genera of that extensive order by having all the filaments of their flower connected at the base into a tube, which sheathes the style. The bearded species, *C. barbatus*, is a native of the mountainous districts of Abyssinia, India, and Nepaul, and was introduced from the first of these countries to Britain in 1806. It is an evergreen undershrub of from 18 inches to 3½ feet in height, and of very remarkable and imposing appearance. Its stems or principal branches are somewhat recumbent, and recurve upward at their extremity; and its flowers have a blue colour, a fine pubescence, and a very elegant form,—they are produced, during October and November, in whorls of six on a like spike,—they have their lower lip turned down, and show their interior form above,—and their regularity of whorl, their remarkably shaped corolla, and the varied colours of their parts of fructification are well exhibited by their peculiar habit of growth.—The fragrant or aromatic species, *C. aromaticus*, was introduced in 1826 from India. It is also an evergreen undershrub; but has pale violet-coloured flowers, and blooms from March till May. Some botanists have ranked the bearded species as a *plectranthus*; and others have ranked the fragrant species as a *gesneria*. About a dozen other species have been scientifically described.

COLEWORT. See CABBAGE.

COLIC. A very painful disorder of the intestines of animals. Spasmodic colic is somewhat frequent in the horse, and occurs much oftener in the small intestines than in the large. It is caused by costiveness, by strictures in the bowels, by tumours in the mesentery, by a feed of succulent herbage after a course of dry feeding, by the sudden application of cold water to the hot skin, and by the drinking of cold water while the system is heated.

Its symptoms are usually sudden, frequently violent, and sometimes liable to be confounded by an unprofessional observer with those of widely different diseases. A horse attacked with colic suddenly evinces great uneasiness, shifts his position from side to side, paws his litter, and impatiently stamps with his feet. An observer of limited experience might readily suppose him to be suffering inflammation of the bowels; but may, by five well-defined points of diagnosis, readily distinguish between that disease and colic. In inflammation of the bowels, the attack is progressive, or passes from mere indisposition to violent pain; but in colic, the attack is quite sudden: in inflammation of the bowels, the pulse is very quick and small; but in colic, the pulse, though sometimes a little quickened, is natural: in inflammation of the bowels, the horse lies down, suddenly rises, and seldom rolls upon his

back; but in colic, he lies down, remains some time down, and rolls abundantly on his back: in inflammation of the bowels, the legs and ears are generally cold; but in colic, the legs and ears are generally warm: in inflammation of the bowels, intermissions never occur; but in colic, short intermissions are frequent.

The necessity of discriminating between inflammation of the bowels and spasmodic colic is very great; and before a remedy in any case is applied, the discrimination ought to be fully, satisfactorily, and promptly made. When colic is seen to exist without symptoms of inflammation, an antispasmodic mixture ought to be speedily administered, and, if requisite, repeated at an interval, according to the severity of the symptoms, of from one hour to four hours. Any of the three following mixtures is confidently recommended by Blaine;—first, half an ounce of ground pepper, three ounces of spirit of turpentine, one ounce of laudanum, and four ounces of soured ale; second, one ounce of sulphuric ether, two ounces of laudanum, one drachm of oil of peppermint, a quarter of a pint of common gin, and a quarter of a pint of soured ale; and third, two ounces of spirit of turpentine, one drachm of oil of peppermint, six ounces of castor oil, and six ounces of watery tincture of aloes. Bleeding ought, in every very severe case, to be speedily practised; and it ought to be more or less copious according to the comparative violence of the symptoms. Other suitable and concurrent remedies, in bad and prolonged cases, are smart friction on the belly, relaxant glysters, very hot fomentations, and a brisk five or ten minutes' trot.

When the colic proves to be flatulent, and develops itself in great and very painful distension, the accumulated gas which causes it, and which is usually a combination of hydrogen with some other gas, must either be chemically destroyed by some such means as a drink of watery dilution of chloride of lime, or drawn off by puncture with the trochar; but the latter remedy should not be used unless the former cannot be had, and the case appears to be one of imminent danger.—Cattle also are subject to colic; and require to be treated for it in nearly the same manner as horses. Frequent popular names of colic are gripes, cramp, fret, and gullion.

COLLAR. The part of harness which encircles the neck, receives the attachment of the draught, and presses against the shoulders of a horse or other animal of draught. Horses' collars are usually made of a stuffing of hair, tow, or straw, within canvass, and covered with leather; they ought, in every instance, to be so formed and adjusted as to offer a cushiony resistance to the utmost available pressure of the animal's power; and they require to be surmounted with such a cape as shall prevent rain from getting between the cushion and the shoulder, there to heat, irritate, and even blister the skin. A large, erect, spreading collar-cape, very

common in many parts of England, is a very absurd appendage, affording no protection from rain, and serving principally to catch the wind, and in consequence somewhat to embarrass the action or neutralize the power of the horse. See the article HARNESS.

COLLEY. A black-faced, black-legged, wiry-woolled sheep; also a variety of dog much prized among some of the rural classes of Scotland. See the articles SHEEP and DOG.

COLLIER. See APHIS.

COLLINSIA. A genus of very beautiful hardy annual plants, of the figwort tribe. The great-flowered species, *C. grandiflora*, was introduced to Britain in 1826, from the dry banks of the Columbia river; and it has already become a very general and somewhat well-known favourite. Its stem has a height of about a foot; its flowers exhibit an elegant combination of blue and white and purple; and its grouping of bloom and foliage admirably adapts it, not only to the ordinary modes of cultivating annuals, but to the forming of broad masses and prolonged lines. The spring species, *C. verna*, vies with the great-flowered in elegance, and has a similar height and habit; the small-flowered species, *C. parviflora*, is inferior in elegance, and has a trailing habit; the two-coloured, *C. bicolor*, is taller than the great-flowered, and blooms through a much longer period, but has none of the blue colour which so richly combines with the others' white and purple; and the various-leaved, *C. heterophylla*, is as tall as the two-coloured, and blooms in July and August. The two last were introduced since 1832.

COLLINSONIA. A genus of perennial, herbaceous, ornamental plants, of the labiate order. The Canadian species, *C. canadensis*, grows wild in moist situations in Maryland and other parts of North America, and was introduced to the gardens of Britain during the first half of the last century. Its stem is quadrangular, and about a yard high; its leaves are cordate and serrated, and grow in pairs upon the stem; and its flowers are purplish-yellow, have a long tubular throat and a segmented top, grow in loose spikes at the extremity of the stem, and appear from August till October. Four or five other species, all from North America, one tuberous-rooted, and one with a fragrance like that of anise-seed, are in cultivation.

COLLOMIA. A genus of beautiful, hardy, annual plants, of the polemonium tribe. They are natives of the same countries, and became known in Britain in the same year, as the Collinsias; but they have not obtained equal favour. The species hitherto best known attains a height of about 9 inches, and bears many flowers of small size and inconspicuous position among the foliage, but of very brilliant scarlet colour, almost vying with some admired kinds of verbenas. Five species were introduced between 1825 and 1834; and the colours of their flowers are severally crimson, pink, saffron, red and yellow.

COLMATA. An artificial process for obtaining deep and fertile deposits of alluvium in some parts of Lombardy which lie lower than the level of the existing channel of the principal rivers. An embankment is raised round the field or farm to be subjected to this process; the dyke of the nearest rivulet is so far broken down as to allow the muddy water of high freshets to escape; and this water is detained in the field till it deposits its mud, and is then let off toward the river by a discharging course from the lower end of the field. This process is usually continued from five or six to ten years, or till it effects deposits to the aggregate depth of from five to eight feet; and it may be so regulated, by means of a greater or less depth in the breach of the rivulet's dyke, as either to continue a comparatively long period and deposit nothing but fine silt, or to continue a comparatively short period and deposit a mixture of silt, sand, and gravel. The process, in consequence of keeping the field for so long a time from any use, is necessarily very expensive; yet the crops of only five years usually repay the whole cost, and the rich crops of succeeding years yield a large amount of clear gain. The crops of the first and second year of the new soil are maize and hemp; and those of the three succeeding years are wheat, without the aid of manure. A process similar to colmata has been practised in the vicinity of Gainsborough.

COLOCASIA,—botanically *Arum Colocasia*. An esculent-rooted plant, of the order Aroideæ. It is cultivated in Egypt and other parts of the Levant for the sake of its esculent roots and leaves; and it was introduced to British hot-houses as a curiosity, so early as the middle of the sixteenth century. Its roots are tuberous; its stems are about two feet high; its leaves are variegated and handsome; and its flowers are green and uninteresting. It is easily propagated from its tubers.

COLOCYNTH,—botanically *Cucumis Colocynthis*. A medicinal, trailing, annual plant, of the cucumber genus. It abounds in Nubia and some parts of Turkey and of the extreme south of Africa; and it was introduced to Britain about the middle of the 16th century, and can be cultivated in a frame. Its root is branching, and strikes deep into the ground; its stems are trailing, hairy, and about two yards long; its leaves are triangular, and grow on long footstalks, and effect an aggregate foliage like that of the common cucumber; its flowers are solitary, axillary, yellow, and campanulate, and bloom from May till August; and its fruit is yellow, about the size of a small orange, smooth, and trilocular, and contains many whitish, ovate, compressed seeds, within an envelop of white spongy pulp. The ripe fruit, peeled and stove-dried, is largely imported to Britain by wholesale druggists; it consists wholly of the seeds and of a very light, tearable, white, cellular matter; and it is free from smell, but has an excessively bitter and

nauseous taste. A pulp or mucilaginous extract, obtained by infusion of the fruit in boiling water, is the substance used in medicine; and this has a gelatinous consistence and a golden-yellow colour, and appears to consist principally of mucus, resin, gallic acid, and a peculiar bitter principle which has obtained the name of Colocytine. The pulp or extract is a very powerful drastic purgative; and is generally administered in combination with milder and modifying purgatives as a cathartic. It was formerly employed, but with great caution, in cases of dropsy, lethargy, and melancholy. Veterinary writers class it among substances which are poisonous to the horse.

COLOMBO. See CALUMBA.

COLON. The first or uppermost of an animal's large intestines. It has its name, which signifies "a hollow," either from its great capacity, or from the circumstance of its being generally found empty or filled only with gas on dissection. The colon of the horse has capacity for no less than about twelve gallons of liquid or pulpy matter; and the colon of the cow, viewed jointly with the succeeding intestines, has the surprising length of about 33 feet. The upper end of the colon is supported by the common mesentery; and the rest floats loosely or freely in convolutions. The matter of an animal's sustenance, on arriving at the colon, ceases to yield any more aliment, and commences to be wholly feculent, thenceforth to hasten onward to expulsion.

COLOUR. A property of light, the knowledge of which can be gained from no description, but is acquired by means of the organ of sight. Colouring substances, or paints, often improperly termed *colours*, are made use of to impart a colour to other substances, either by application or admixture. White and black are counted among colours in the latter sense, but not at all, or seldom, in the former, in which sense a white body is very properly called *colourless*. Black is merely the absence of all light. Colours, both alone and united, have different properties, and produce different effects upon the organs of sense, by means of their harmony or contrast, which are particularly important to painters, and are properties arising from the nervous sensibility. Thus scarlet is a burning colour, injurious to the eyes; and it is probably on this account that beasts are so violently excited by it. Yellow is the brightest, red the warmest, deep brown and violet the softest among colours.

The doctrine of colours, in a general sense, is the science of the origin, the mixture and effects of colour, as a property of light. How, for instance, is it, that light at one time is coloured, at another white? and by what laws are the appearances of colours governed? The glass prism was the first contrivance that gave a satisfactory solution of these questions, and Sir Isaac Newton the first philosopher who explained and published

the solution. If a ray of light is allowed to pass into a dark room through a small opening in a shutter, and is made also to pass through a smooth, three-sided glass prism, we find, 1st, that the ray of light, at its entrance into, and at its passage out of the glass, is turned from its direct course; it is said to be refracted into a different direction; 2d, that the ray of light, which, falling directly upon a piece of paper before the prism, produces a round white spot, produces, when the paper is held behind the prism, a coloured figure, about five times as long as it is wide, and exhibiting the colours of the rainbow, arranged in the same order as they are seen in that phenomenon. This figure or appearance is called the *prismatic spectrum*. The length of it is found to be in a direction perpendicular to the axis of the prism. It is red at the end which is nearest to the refracting angle of the prism, and violet at the end most remote from it, while orange, yellow, green, blue, and indigo, follow each other in the intervening space. Newton concluded from this, and a great variety of similar experiments, that these coloured rays are the simple rays of light, and that white light is composed of the union of them all, according to the relations which they exhibit in the prismatic spectrum. Every white ray of light, therefore, contains all the coloured rays united; but they are not recognised by us, since they produce upon the retina, where they are thus united, the impression we term *white*. These coloured rays are reflected from all bodies according to similar laws, so that reflected white light is still white; but they are refrangible in different degrees; this property being least in the red rays, moderate in the green, and in the greatest degree in the violet; and they are, on this account, separated from each other whenever they are refracted; since, from their different refrangibility, although they are parallel, when they fall upon the refracting substance, they take different lines of direction in passing through it. They follow each other, in this respect, in the following order; first violet, then indigo, blue, green, yellow, orange, and red. When these same coloured rays are rendered parallel again, and so fall upon the eye, they appear white, as at first. Most bodies possess the property of fixing or absorbing some of these coloured rays, which fall upon them, and thus only reflect or transmit rays of a particular colour; and upon this property, according to Newton, the colours of all bodies depend. Blue silk, for example, absorbs six coloured rays, and reflects only the blue; and a solution of cochineal transmits only the red, and absorbs all the other rays. All this is confirmed by the experiments with coloured disks revolving rapidly upon a rod, and with the coloured spectrum falling upon coloured bodies.

COLOURS OF PLANTS. We find in plants eight fundamental colours, which are called pure and unmixed colours—white, grey, black, blue, green, yellow, red, and brown. Each of these ex-

hibits seven varieties, which, in respect to their gradations, are entirely equal and alike. Thus, for example, of white, there are pure or snow-white; whitish or dirty white; milk or bluish white; amianthus or greyish white; ivory or yellowish white; *parzellan* or reddish white; and chalk or brownish white. The blue crocus often changes into yellow; the blue violet to white; the blue columbine to red; the red tulip to a yellow, and the yellow to a white, &c. The same thing may be observed in fruits. Linnæus has inferred the properties, and especially the taste of plants, from their colour. Yellow is generally bitter, red sour, green denotes a rough alkaline taste, paleness a flat taste, whiteness a sweet, and black a disagreeable taste, and also a poisonous, destructive property. Colours, in the vegetable as well as in the animal world, appear to be in truth a secret of nature. How, for instance, bright yellow and deep red or green are made to appear side by side upon a leaf, separated by the finest lines only, and yet not produced by any variety of properties which is perceptible to any of our senses, is a mystery to us. Moreover, nature, in some cases, appears to distribute colours with the greatest regularity, while, in other instances, she sports in the most lawless irregularity.

COLT. A young horse. See the article HORSE.

COLT'S-FOOT,—botanically *Tussilago*. A genus of hardy, herbaceous, perennial-rooted plants, of the jacobea division of the composite order. The common species, *Tussilago farfara*, is a frequent and most troublesome weed of the moist, marly, and clayey soils of Britain; and figures as an officinal plant both in the herb-list of almost every old wife quack of the country, and in the pharmacopœias of Edinburgh and Dublin. Its root is long and diffusely creeping; its stems or flower-stalks are simple, erect, woolly, unifloral, and about 6 inches high; its flowers droop while in the bud, but stand erect when in bloom, and have a golden-yellow colour, and appear in March and April; its seed-down is sessile, rough, white, and shining; and its leaves are radical, footstalked, erect, cordate, angled, serrated, very large, and of slow development,—green, smooth, and red-veined above, and woolly and white below,—and they develop themselves after the flower, so that the plant appears all-flower in spring, and all-leaf in autumn. Both the dried flowers and the dried leaves are used in medicine,—the former gathered at their maturity, and the latter in young state or incipient development; and they are exhibited sometimes in decoction, but far more frequently by smoking in the manner of tobacco. The smoking of colt's-foot, in fact, has been practised since the time of Dioscorides, and might, at the present day, be very advantageously substituted for tobacco-smoking, or rather maintained for a few days as a cure of the filthy, abominable, and diseased taste of tobacco-smokers. Colt's-foot is usually prescribed

for chest-affections, but really has little effect upon them; yet in cases where a man will smoke, it may, as a substitute for tobacco, prevent the sickliness of appetite, the emaciation, the cadaverousness, and the stupidity which all tobacco-smokers are liable to contract.

Colt's-foot, regarded as an agricultural weed, usually occurs in moist fields which have been overcropped or scourgingly treated; and, when it has once established itself, it rapidly multiplies from seed and from all the pieces into which the plough cuts its rambling roots,—and cannot be restrained without great labour, or extirpated without laying down the ground to grass. The preventing of it from seeding, and the careful gathering up of all discoverable portions of its roots are the best means for repressing its extraordinary and mischievous fecundity. Mr. Lisle states that a neighbour of his almost smothered it with two successive crops of vetches, and expresses a confident opinion that it may be thoroughly suffocated by such a five or six years' course of grass as shall cover and mat all the surface of the ground with a thick and dense sward. He ploughed up broad clover in the beginning of July, and turned up roots of colt's-foot, in which he observed, between earth and air, many little buds as if destined to be flowers or leaves of the following year,—and at the depth of from 5 to 7 inches, shoots of a callous body as if destined to be future roots. A winter's fallow has little destructive power over colt's-foot roots; and even a summer's fallow permits all portions which are in any degree buried by the soil to shoot and bud and carry on the process of propagation,—and, in order to be in any tolerable degree effective, must be accompanied by the hand-picking and burning of all parts of the plant which can be seen.

A variety of common colt's-foot with variegated leaves, *Tussilago farfara foliis variegatis*, is sometimes grown as an ornamental plant in gardens.—The butter-bur colt's-foot, *Tussilago Petasites*, is a weed of the moist meadows of Britain, having a flower-stem twice the height of that of the common species, and carrying thyrses of flesh-coloured flowers in March and April.—Two one-flowered species from Austria, and four thyrses-flowered species from Germany, Labrador, Lapland, and Italy, have a handsome appearance, and in two instances bear lilac and purple flowers, in others white and pale. Six or eight other foreign species are known in Britain; and several plants formerly regarded as colt's-foot are now assigned to other genera.

COLUMBINE, — botanically *Aquilegia*. A genus of hardy, perennial-rooted, herbaceous, ornamental plants, of the ranunculus tribe. The common species, *Aquilegia vulgaris*, grows wild in woods and pastures in some parts of Britain; and, in its double and improved varieties, has a very frequent and favourite place in the parterre. The stem of the wild plant is usually about 2

or 2½ feet high; and the flowers have a dark blue colour, and have shorter petals and more prominent nectaries than the garden varieties. Seeds of the wild plant very seldom sport or vary. The garden varieties exceedingly differ from one another, not only in the colour and fulness, but also in the form, of their flowers. Some, called rose columbines, have no visible nectaries, and are as double-flowered or many-petalled as the larkspur; and these comprise numerous sub-varieties, with respectively blue, red, white, and chestnut-coloured flowers, or with exquisite variegations of some two of these colours. Others have sharp-pointed petals, expanding like the rays of a star; others have their petals in an inverted form; others have a horn-like expansion of petals; and all these comprise subvarieties, distinguishable from one another by their colours or by their comparative singleness or fulness. "From the different shapes of these flowers," remarks Miller, "any person not well skilled in the culture of plants would suppose they were distinct from the others; but having several years sown their seeds, which were collected with great care, I have found them always varying from one to the other." Propagation may be effected either from seeds or by the division of the roots; but, when conducted in the latter method, it rapidly induces degeneracy.—Upwards of a dozen species of columbine, all ornamental, most about 15 or 20 inches high, and the majority with purple or blue flowers, have been introduced from Siberia, Switzerland, and similar countries; and six of these are enumerated in Mawe's systematic catalogue of choice plants,—*A. viscosa*, *bicolor*, *alpina*, *canadensis*, *atropurpurea*, and *viridiflora*.

COLUMBIUM. An elementary metallic substance. It was discovered in 1801; it exists, in most of its ores, as an acid in union with the oxides of iron and manganese; and it combines with other elements, particularly oxygen, chlorine, and sulphur; but it is neither plentiful nor peculiar enough to be of much consequence to the arts. It is obtained in the form of a black powder, and acquires the metallic lustre from compression.

COLUMBO. See CALUMBA.

COLURNA. See HAZEL.

COLUTEA. See BLADDER-SENNA.

COLZA. See COLE.

COMARUM. See CINQUEFOIL (MARSH).

COMBRETUM. A genus of ornamental tropical plants, forming the type of the natural order Combretaceæ. This order comprises the genera *combretum*, *quisqualis*, *terminalia*, *bucida*, *conocarpus*, *getonia*, and *poivreia*; and it has, within the gardens of Great Britain, about 40 species,—nearly all tropical. Some of the species of *combretum* and *quisqualis* are most magnificent climbing plants, and, in their native country, adorn the trees of the forest with festoons of noble foliage, and garlands of brilliantly yellow, white, and crimson flowers. Some species of the

order are officinal; and the nutty fruits of several are esculent.—Seven or eight species of the genus *combretum* were introduced to our hot-houses between 1818 and 1826; and about 40 other species have been scientifically described. The dwarf and the large-flowered, *C. nanum* and *C. grandiflorum*, are evergreen shrubs,—the former two feet high, with white flowers, and the latter from 5 to 10 feet high, with scarlet flowers; and all the other introduced species—as well as about half a dozen which have been transferred to other genera—are climbers of great height and surprising beauty.

COMBUSTION. It is not easy to give a correct definition, or to assign a general cause, of this familiar phenomenon. It may, however, be described as the result of the combination of two or more bodies, attended with a disengagement of heat and light. This description distinguishes combustion from *ignition*, which is merely the result of an elevation of the temperature, without any chemical combination. Fire was formerly considered as an element, which had the power of converting certain bodies into its own nature; but the progress of chemical science soon showed the error of this notion. Stahl's celebrated theory was founded on the hypothesis of the existence of a substance which he called *phlogiston*. Every combustible body was supposed to contain this substance, which was disengaged by combustion: the loss of the *phlogiston* was the cause of the residuum being incombustible. The heat and light were attributed to the violent agitation of the *phlogiston* at the moment of its disengagement. The discoveries of Black and Priestley opened the way to the system of Lavoisier, which, in 1785, entirely supplanted the theory of Stahl. During the conversion of solids into fluids, and of fluids into vapours, there is a considerable absorption of heat: when, on the contrary, vapours and liquids are restored to the fluid and solid form, the heat which they contain is evolved, and passes from the latent to the sensible state. See COLORIC. These views were assumed by Lavoisier as the basis of his theory. Oxygen gas was considered as a compound of a peculiar basis, united to the matter of light and heat, and combustion as the combination of oxygen with the burning body. During the combustion, the basis, combining with the combustible, augmented its weight and changed its properties; while the imponderable elements of the gas—light and heat—were developed in the form of flame. But facts prove this theory incorrect. In the first place, all the phenomena of combustion take place, in many cases, without the presence of oxygen. In the second place, there are many cases in which oxygen unites with bodies, without the evolution of light and heat, as during the change of some metals on exposure to the air. And, further, there are many instances in which combustion takes place not only without condensation, but where gaseous matter is actu-

ally produced from solid matter, as in the inflammation of gunpowder. Besides, the evolution of light, if it were derived from the gas, should be proportional to the quantity solidified, whereas it depends chiefly on the combustible. The first of these objections to Lavoisier's theory, which is yet generally received, has been partly removed by modifying the definition so as to extend it to several other bodies, hence called *supporters of combustion*. The definition which we have given of this phenomenon at the beginning of this article is merely a description. The question arises, Whence come the light and heat? They are generally referred to the condensation which is almost always a necessary consequence of a chemical combination; but we have already seen that, in some cases, they are produced where the component parts actually pass from a solid to a gaseous state. It seems probable, in the present state of our knowledge, that they may be attributed to the disengagement of the electric fluid. "In every chemical combination," says Berzelius, "there is a neutralization of opposite electricities, and this neutralization produces the heat and light in the same manner as it does in the Leyden jar or the galvanic battery." But to this it may be objected, that, if electricity were the cause of the disengagement of the heat and light, they would always bear a fixed proportion to each other. This is not the case: the combustion of oxygen and hydrogen disengages a very great quantity of caloric, but very little light; that of phosphorus and oxygen produces opposite results. There is, then, no theory of combustion, at present received, which will explain all the circumstances of this phenomenon. If there be any one general cause, it must be one which, like affinity, is modified by the nature of the agents and the peculiar circumstances of their mutual action.

COMFREY,—botanically *Symphytum*. A genus of hardy, perennial, herbaceous plants, of the borage tribe. The very rough species, *Symphytum asperrium*, was introduced to Britain from the Caucasian mountains in 1799, and has, for a number of years past, drawn the attention of agriculturists as probably a valuable forage plant. Its root is tuberculated, branching, thick, and fleshy; its stem is very prickly and from 6 to 10 feet high; its leaves are rough-stalked, heart-shaped, broad, tapering to a point, and of a bluish-green colour; its flowers are cylindrical with a campanulate inflated limb, and have a changeably blue and red colour, and appear from May till September; and its seeds are naked, gibbous, and not pierced at the base. Both its root and its stem are very farinaceous; its root is probably as esculent as that of *Stachys palustris*; its stem has sometimes been blanched and eaten like that of angelica; and its shoots and leaves, during all the period intermediate between the seedling and the hardened conditions of the plant, are greedily eaten by cows. It was brought into notice as an agricultural plant, by Mr. D. Grant, a nursery-

man of Lewisham, and was introduced to Ireland, and recommended to the cottier-farmers of that country, about eight years ago, by Dr. Derenzy. Young mentions it in his Farmer's Calendar, under the name of trotties, and appears to think that the whole plant is valuable; but Dr. Derenzy supposes the roots to be useless for either man or beast, and recommends the plant solely for shoots and foliage. It is easily propagated; and, when once established, it will, without any renewal, produce enormous crops for many years. Its seeds seldom ripen, and its seedling plants grow slowly to maturity; but its roots possess the power of facile and rapid reproduction, and may, at any time from October to April, but especially in February or March, be taken up, cut into small pieces, and set in drills at distances of two feet from drill to drill and 15 inches from plant to plant. The plant will thrive in poor, dry, exposed soil; yet it ought, if possible, to have good deep soil, and will well repay an abundant dose of manure; and as it yields large and constant produce for a long series of years, it requires, of course, to be grown apart from any course of rotation. It should be cut about the time of flowering, and never allowed to go to seed. Its ordinary annual produce, in green fodder, was estimated by Mr. Grant, and has since been estimated by practical agriculturists, at about 30 tons per acre; and, in an experiment on the farm of Carnew Castle in Ireland, it amounted to the enormous quantity of 82 tons per Irish acre, in three cuttings of 28½ tons in the middle of April, 31 in the middle of July, and 22½ in the middle of September. It is preferred to vetches by pigs; it is not, like clover, dangerous to cows or sheep; and it does not communicate any bad flavour to cows' milk. A small hybrid variety of it was originated in 1825. The normal plant is represented in *Plate XXI*.

The officinal comfrey, *Symphytum officinale*, is indigenous in Britain, and may be found by the sides of ditches and in other moist situations. Its root is tuberous, thick, full of a slimy juice, externally black, and internally white; its stem is erect, thick, and usually about 4 feet high; its leaves are long, pointed, rough, and deep green; and its flowers are generally white, yet often reddish, and appear from May till July. The slimy mucilaginous matter of the root has sometimes been used in medicine as a demulcent, and has acquired for the plant its specific botanic designation; but it is of very little value. A variety of this species, known as *S. o. patens*, attains the same height as the normal plant, and carries blue-coloured flowers.—The tuberous species, *Symphytum tuberosum*, grows wild in moist shady places in Scotland. Its root is tuberous; its stem is knobbed, branched, and 3 or 4 feet high; and its flowers are drooping, have a yellowish white colour tinged with green, and appear from May till October.—Seven species, besides the very rough, have been introduced from foreign coun-

tries; all have an ornamental appearance; and several, as well as the two indigenous species, have economical properties similar to those of the very rough, but cannot compete with that species in either productiveness or facility of adaptation.—*Lawson's Agriculturist's Manual*.—*Doyle's Husbandry*.—*Low's Elements of Agriculture*.—*Miller's Dictionary*.—*The Gardener's Magazine*.—*Loudon's Hortus Britannicus*.

COMMELINA. A genus of ornamental herbaceous plants, constituting the type of the natural order Commelinæ. This order comprises the genera *tradescantia*, *cyanotis*, *dichorizandra*, *cartonema*, *campelia*, *callisia*, and *aneilema*; and it has, within the gardens of Great Britain, upwards of 70 species,—all herbaceous, and about four-fifths of them more or less tender. A large proportion of the order are plants of great beauty; and most of these have blue, reddish, or white flowers. The great majority are natives of America; and not one species exists in Europe except as an exotic.

The genus *Commelina* comprises at least 50 known species; and about 25 of these have been introduced to Britain. The common species, *C. communis*, is a hardy annual, and was first brought from America in 1732. Its stems are trailing, stoloniferous, and about two feet long; its leaves are oval, spear-shaped, pointed, smooth, and deep green, and occur singly at the joints of the stems, each leaf embracing the joint with its base; and its flowers grow on footstalks in twos and threes, from a compressed spatha, out of the bosom of the leaves, and they have each two large blue petals and four smaller green ones, often mistaken for sepals, and appear in June and July.—The upright species, *C. erecta*, is a hardy, evergreen herb, and was introduced from Virginia in 1732. Its roots consist of numerous white fibres; its stems are erect, rough, herbaceous, 12 or 18 inches high, and about the thickness of goose-quills; its leaves are similar in form and manner of growth to those of the common species; and its flowers are produced on short footstalks from the bosom of the leaves at the upper part of the stem, have a pale bluish colour, and bloom in August and September.

Two of the other introduced species are deciduous perennial herbs, two are tuberous-rooted, one is an annual, and all the rest are evergreen herbs, either erect or trailing; the greater number are more or less tender, nearly all have blue flowers, and all, with one exception, are very decidedly ornamental. One of their chief favourites is the sky-blue species, *C. caelestis*, an erect, evergreen herb, of about 20 inches in height, introduced in 1813. This requires greenhouse or even hothouse treatment in winter, but does well in either beds, masses, or single plants, in the open border during summer; and it can easily be so managed, by successive sowings, and by the forcing of its roots, as to afford an uninterrupted series of bloom throughout the year.

COMMON, or COMMONAGE. A property in soil, pasture, turbary, fishery, or coppice, belonging not to any individual, or private party, but to all the inhabitants of a parish or district. A commonage pasture is always a wasteful disposition of land; for, except in rare instances, it is neither weeded, manured, nor otherwise properly managed; and it, in consequence, affords far less herbage for the stock fed upon it than if it were enclosed and regularly farmed. Commonage arable land is in comparatively worse condition, never being properly worked, or subjected to wise courses of cropping, or suffered to recover the effects of the maltreatment and exhaustion which they experience. The practical abolition of the right of commonage, no matter how effected, is, in almost every instance, a great economizing of land and a saving to the public; and when so adjusted as to appear to give the common-holders no more than a bare equivalent for their property, it deals them the grand boon of deliverance from a slovenly, wasteful, and execrable system of farming.

COMPARETTIA. A splendid, singular, and recently discovered genus of plants, of the orchis tribe. It first became known in Britain in 1836; and three species of it were introduced before 1841, two from Peru, and the other from Mexico. It has the unique structure of the labellum being prolonged in the form of two spurs, formed by the united pair of lateral sepals; and it thus presents the same peculiarity among the orchidæ which the larkspur genus exhibits among the ranunculaceæ. The pseudo-bulbs of the scarlet species, *Comparettia coccinea*, are small; its leaves are narrow, thick, leathery, oblique at the apex, green above, and purple or pink below; its racemes are terminal and subsecund; its peduncle is slender, and furnished with a few small scales or bracts; and its perigone is ringent, and has the lip obcordate, spreading, slightly notched at the margin, and provided with two plates at the base.

COMPOSITÆ, or COMPOSITE-FLOWERED PLANTS. A most extensive and very important natural order of plants, coextensive with the Linnæan class Syngenesia. Each of its flowers is literally compound, or has a number of florets enclosed in a common perianth, and arranged on a common receptacle, or produced in involucreated heads or calathidia; and the flowers of very many of the genera, like those of the daisy or the dandelion, have a rayed or stellate appearance. The number of genera in the order is about 300, and the number of species wild or cultivated in Britain very nearly 3,000, and rather more than two-thirds of all the latter consist of hardy herbaceous plants. The Linnæan system distributes the compositæ, under the name of syngenesious plants, into the five orders *sequalis*, *superflua*, *frustranea*, *necessaria*, and *segregata*; and some of the most recent modifications of the Jussæuan system distribute them into the nine great divisions

cichoraceæ, labiatifloræ, carduaceæ, astereæ, eupatoriæ, jacobææ, helianthææ, ambrosiaceæ, and anthemidiæ, — and subdivides the cichoraceæ into seven groups, and the carduaceæ into four groups. A popular view of the latter distribution exhibits all the compositæ in seventeen groups, under the representation of respectively hawkweed, dandelion, cat's-ear, lettuce, scorzonera, chicory, leria, true-thistle, globe-thistle, vernonia, everlasting, starwort, eupatorium, groundsel, sunflower, ambrosia, and chamomile.

A large proportion of the compositæ are showy, and many possess a considerable or even great degree of elegance and beauty; yet very few are popularly regarded as ornamental, and only dahlias, cinerarias, Chinese chrysanthemums, sunflowers, marigolds, arctotises, China asters, centauries, and daisies are generally to be found in gardens. A considerable proportion of them have yellow-coloured flowers; but many have other colours; and some are remarkable for either the variegation or the brilliance of their tints. A comparatively great number are more or less medicinal; and a fair proportion are subservient to the purposes of the kitchen or to the arts. Familiar examples of medicinal compositæ are chamomile, colt's-foot, tansy, worm-wood, marigold, golden-rod, lettuce, eupatorium, and arnica; and familiar examples of culinary and esculent compositæ are artichoke, cardoon, succory, salsafy, scorzonera, lettuce, and endive.

COMPOST. A mixed manure, or fertilizing compound. Composts for the purposes of the florist are exceedingly numerous; most of them consist wholly or principally of organic matters; many are compounded with the view of uniting the powers of several organic manures; and not a few are intended to act by both feeding and stimulating, or to combine the highest possible chemical force with the utmost practicable organic adaptation. All these composts supersede ordinary manures, or possess the character of either specific or superlative fertilizers. But composts for the farm are supplementary to ordinary manures; they are used, not because common manures are unsuitable, but because they are comparatively scarce or dear; and all, or almost all, are mixtures of mineral and organic matters,—the mineral matters of most being preponderant, and the organic matters, till subjected to the chemical processes of the compost, being worthless and refractory. Specific horticultural composts are occasionally noticed in our articles on the plants for which they are used; and only the most common or remarkable agricultural manures can claim to be noticed in the present article.

A very common compost is formed by a mixture of lime with weeds, hedge-clippings, dry leaves, and other refuse vegetable matters of the kind which are sometimes burnt for the preparation of manurial ashes. See the article **ASHES**. By the action of lime upon refuse vegetable matters,

a soluble manure is formed, the refractory and worthless character of the refuse vegetables is destroyed, the hard and fibrous or the succulent and spongy organisms are decomposed, and a mass of putrid matter results, opulent in the elements of vegetable nutrition, and both chemically and mechanically fit to be absorbed by the spongioles of the cereal grasses or of other agricultural plants. This compost contains all the saline ingredients of the vegetable refuse employed in its formation, and, as respects these ingredients, is as powerfully manurial as ashes of corresponding character; and it also contains most of the organic matters which the combustive process or incineration would have driven off in aeriform decomposition, and, as respects these, is much more powerfully manurial than ashes. It wants indeed the carbonate of potash which ashes possess; but it contains in lieu of it an excess of lime, and can, by means of this, perform as high and valuable a chemical action as if carbonate of potash were abundantly present. Yet dearth of lime, preponderance of ligneous matter in the vegetable refuse, or any one of a dozen other circumstances, may sometimes render the preparation of this compost less economical than the preparation of ashes; and when lime is cheap, the preparation of compost with the succulent and herbaceous portions of the vegetable refuse, and the preparation of ashes with the woody and twiggy portions of it, may be the most advantageous method. A compost of lime and vegetable refuse ought, whenever circumstances admit, to be enriched with the addition of vegetable ashes, and especially of animal refuse.

Another very common compost, often good, sometimes bad, occasionally execrable, and very seldom rightly understood, is a decomposing mixture of peat and lime, or of peat and farm-yard dung. Peat, in its natural condition, is a foe to all useful vegetation,—insoluble in itself, and so saturated with antiseptic properties as to prevent the beneficial action of all other substances; but when decomposed by means of lime, or of farm-yard dung, it loses its bad qualities, and surrenders its organic and saline elements as available food for other plants. Yet any compost with peat can be economical only when suitable materials for it can be readily and cheaply obtained; and never, in even its richest combinations or with its highest possible power, can it compare with some other common manures, especially with bones, guano, or farm-yard dung. When lime is cheap, and peat exists upon the spot, a compost may be made of them, suitable for most of the purposes of the farm; and when farm-yard dung is scarce, and peat can be obtained in the vicinity, a compost of seven parts of the dung, and twenty-one parts of the peat, though much inferior to the mere dung in quality, will so greatly exceed it in quantity and in dispersiveness as to be very decidedly advantageous. The best kind of peat for any compost is the kind

known as water-borne peat or water-slain moss, which possesses a sort of alluvial character, or has been floated away, comminuted, and deposited by water; and the most suitable soil for receiving benefit from peat composts, especially from such as contain a large proportion of the peat in an ill-decomposed condition, is adhesive clay or such other as wants porosity and does not admit a sufficient aeration.

But composts by no means possess the value which general opinion has of late years assigned to them, and ought not to be allowed the prominence in the aggregate practices of agriculture which they have recently assumed. Even when both lime and peat are abundant, many a farmer might probably realize far better returns from using the lime to reclaim the peat soil in situ, than from the digging up of the peat and the mixing of it and the lime into a compost for other land. Though all pure peat is organic matter, and might, on that account, appear to be eminently fitted to yield the elements of vegetable nutrition, yet it is organic matter of the rankest kind, destitute of all the proximate principles of the most useful sorts of plants, and packed with such antiseptic and acrid secretions as are positively mischievous to valuable vegetation. The herbage of all moorlands and peaty grounds progressively increases in rankness and coarseness from the exhaustion of the proper nutriment of the finer plants; and the peat generally employed for making composts is dung from the higher or more recent strata of peaty grounds, and therefore consists wholly or almost wholly of the elements of the most wretched herbage. "But," says Dr. Madden, "the question will be asked, Why should such an origin be considered a disadvantage? Two answers can be given to this question. (1.) Because the compost will contain the peculiar saline compounds which naturally exist in these plants; and consequently its employment as manure will tend to reproduce these useless weeds, especially in soil at all predisposed to infection. Lest any of my practical readers should imagine that this objection is purely theoretical, I would just call their attention to the following practical fact. All persons who are acquainted with the herbage of peaty soils, must have noticed the great quantities of sorrel, *Rumex acetosella*, which grow wherever the soil is at all dry. Now, in a paper upon the properties and uses of peat, by John Nasmyth, Esq., published in the Highland Society's Transactions, he expressly states, that peat-manure should not be used for 'light blowing sands' (the kind of soil most prone to infection) 'as it would increase the distemper of the soil, and promote the growth of *Rumex acetosella*.' And again, in an excellent paper upon the use of lime, published some time ago in America, the author mentions, that one of many benefits derived from the use of this substance, is the destruction of the *Rumex acetosella*, and other acid plants, which grow

so abundantly on the poorer soils in his neighbourhood; but lime and peat are so far incompatible, that the former always destroys the characteristic properties of the latter. I may here remark, that this last observation proves that peat-compost with lime is less objectionable in *this respect* than that formed with farm-yard dung. (2.) But another answer may be given to the question, which again refers more to the lime-compost, namely, that, as the quantity of *azote* contained in plants gradually increases as we go up the scale of vegetables, and as the utility of manures for the higher orders of plants—as, for example, our cultivated crops—depends directly upon the quantity of azote which they contain, it follows that a manure derived from *the lowest species* of plants must be but ill fitted for the purposes of the farm; although, in the case of compost with farm-yard dung, this objection will be less valid, on account of the large proportion of azote existing in that substance, which, of course, will add to the quantity contained in the compost."

Another very common compost is a combination of farm-yard manure with the scrapings of roads, the sweepings of ditches, the clearings of headlands, and generally with all kinds of rough and waste mixtures of earthy and vegetable matters. The mixing of farm-yard manure, while in the initial stage of decomposition, with earth and inert vegetable matter, consisting of the decayed roots and leaves of grasses and other plants, reduces it to a humid and soluble condition, prepares it for absorption by the spongioles of a young crop, and greatly increases its bulk without deteriorating its quality. The earthy and waste vegetable matters imbibe a large proportion of the nitrogenous juices which, in unmixed farm-yard manure, usually evaporate or become gaseous during the process of fermentation; and, in consequence of the imbibition of these juices and the decomposition of their own organic and saline principles, they become, in many instances, almost or even altogether as powerfully manurial as the dung with which they are mixed. A compost of this kind may, according to ruling circumstances of economy, be formed either in the yard in which the dung is kept, or on the headlands of the fields to which it is to be applied. If the quantity of urine to be imbibed from the cattle-sheds be considerable, and the earthy and waste materials be near, the compost may be most advantageously formed in the farm-yard; but if the urine be economically drained off into a receptacle for liquid manure, and the earthy and waste materials be much nearer to the fields than to the farmery, the compost ought to be formed on the headlands. The manner of forming the compost is to spread alternate layers of the farm-yard manure and of the earthy and vegetable rubbish, each six or eight inches thick, and all as nearly as possible regular, to cover the whole with a coat or envelope of earth, till intermixture

takes place by decomposition, and then to proceed with it by carting and turning, nearly in the same manner as with unmixed farm-yard dung. In selecting the earthy and waste vegetable matter for the compost, the refuse of such grassy and luxuriant places as differ most widely in character from the fields to which the compost is to be applied, ought in every instance to be preferred; for refuse of this kind is most likely to abound in those elements of nutrition which the fields have in a great degree ceased to possess; while the refuse of grounds precisely similar in character and condition to the fields which are to be manured could afford no supply of these particular elements of nutrition, and might possibly add to the quantity of some deleterious excremental principle which the fields have acquired from recent cropping. "Earth taken from arable fields that have been long in cultivation," remarks Mr. Sproule, "seems the least suitable to enter into the composition of compost heaps; and, even when in combination with the dung, possesses no fertilizing properties that would not be produced by the application of the same earth and dung separately, for there is generally comparatively little inert matter in this description of earth to be rendered soluble."

A common and very useful compost on sea-board districts, particularly around the whole coast of Ireland, is a mixture of sea-weed with sand or earth; and when, as in many districts of the Scottish Hebrides and the west and south of Ireland, the sand of the mixture is calcareous, or consists in a large degree of finely comminuted shells, this compost is signally fertilizing. A compost slightly akin to this, yet of a peculiar and curious character, has been very successfully used in the county of Cork. It is prepared as follows:—"Let a platform of sods or clay, the richer the better, be formed, about 6 inches thick, 12 feet wide, and as long as may be necessary for the extent of the land to be manured. At one end of this, let the first load of lime, fresh from the kiln, be placed about 4 inches thick. Let the lime be then not only slacked but moistened with a solution of rock-salt, or any common salt in water, at the rate of six pounds of salt to each barrel of lime, pouring the solution or pickle gradually and evenly on the lime, as the latter is found to imbibe it. Then spread the lime, thus moistened, two or three inches thick on the platform, and cover it with 4 or 5 inches of clay. Let the second load of lime be laid on the platform near the first, and treated in the same manner. When the entire platform is thus covered, begin again with a second layer of lime; slack, moisten, spread, and cover it as the first, until it be also finished, and proceed in the same manner with a third and fourth layer. If the bed be not collected in one place, but deposited in a long row, as when the earth of a headland is used, one or two layers of lime and earth will be more convenient, and will be equally advantageous. When

the whole is covered with earth, let the heap be cut down and well mixed; in which state it may be suffered to lie until a short time before it is used, when it should be again turned. The proportion of water in which the salt is dissolved, depends on the state of the earth or mould. If the latter be wet, 20 gallons of water with 6 pounds of salt dissolved in it, is sufficient for each barrel of lime; if it be dry, half a hogshead of water to that quantity of salt and lime will be necessary. Forty barrels of lime treated in this manner, is a full dressing for an acre of potatoes; half the quantity is enough for a top-dressing of an acre of land." [Doyle's Cyclopædia of Practical Husbandry.] But though this compost may be perfectly suitable to arenaceous soils, under the frequent or excessive potato cultivation of Ireland, it is clearly and broadly disqualified, by its enormous deficiency in nitrogenous matter, to act as a proper fertilizer of almost any soil under the best rotations of cereal husbandry. The principles of its power are explained in our articles on ALUMINA and ALKALIES; and the principles of its unsuitableness for cereal crops are explained in our articles on AMMONIA and AZOTE.

Most good composts for stimulating and renovating grass lands, or for application in the form of top-dressing, are combinations of earths, clays, sand, lime, and vegetable matter; and require to be frequently turned and well pulverized, in order that their ingredients may thoroughly act upon one another, and that the particles of the whole may readily mix with the sward.—When a valuation of composts is required on occasion of the quitting of farms, a calculation is made of the cost of the materials, the cost of carrying them, the cost of mixing and applying them, and the comparative durability and power of their action; and according to the aggregate weight and tendency of these circumstances is the amount of valuation. But in all ordinary cases, all materials obtained within the limits of the farm are adjudged free from cost, and the power of any middle-rate or average compost is regarded as exhausted after two crops of corn, two mowings of grass, or four years of pasture. The very multifarious manure which is obtained from the daily cleansing of large towns, may probably be viewed as a very emphatic compost; yet it has a character of its own almost as distinct as its origin, and will be noticed in its proper alphabetical place as POLICE MANURE.—*The British Farmer's Magazine*.—*Quarterly Journal of Agriculture*.—*Transactions of the Highland Society*.—*Davy's Agricultural Chemistry*.—*Sproule's Agriculture*.—*Hunter's Geographical Essays*.—*Doyle's Cyclopædia of Husbandry*.—*The Gardener's Gazette*.—*Knowledge Society's British Husbandry*.—*Bayldon on Rents and Tillages*.—*Miller's Dictionary*.

COMPOUND FLOWERS. See COMPOSITE.

CON-ACRE. A retail and extortional system of letting land in many parts of Ireland. Most

of the persons who let land on this system are middle-men; and all, or very nearly all, the persons to whom it is let are cottiers, very small farmers, or parties in a state of extreme penury. The rent is exorbitant,—sometimes fivefold or sixfold the real value; the pieces of land let are, in general, very small,—sometimes one or two roods or even but a few perches; the kind of land let is sometimes old pasture, sometimes rich ley, and generally such as contains a large proportion of mould and grassy fibre; the general course of cropping is first two successive years of potatoes, and next a constant round of corn till the ground will no longer repay seed and labour; the usual georgical treatment is uniformly to apply no manure, and occasionally to pare and burn; and the common consequences are the conversion of some good land into comparative wilderness, the reduction of most land to temporary exhaustion and uselessness, damage to the landlord, confirmed penury and wretchedness to the working tenant, and the prolongation of the reign of agricultural ignorance and barbarism over vast districts of one of the most beautiful and naturally fertile countries in the world.

CONCENTRIC LAYERS. See BARK and WOOD.

CONCRETE. A term given to a species of hydraulic cement, sometimes known as *beton* or *grubstone-mortar*. In preparing concrete, the following proportions have been found to succeed perfectly in some recent structures.

Hydraulic lime, (unslaked,) . . .	0.30 parts.
Sand, (middling,) . . .	0.30 —
Cement, (common clay,) . . .	0.30 —
Gravel, (coarse,) . . .	0.20 —
Chippings of stone, . . .	0.40 —

The lime, sand, and cement, are, in the first place, thoroughly worked up into a homogeneous mass of a hard temper; this mass is suffered to rest in a heap about twelve hours; it is then spread out into a layer about six inches thick, and the gravel and stone are evenly spread over it, and the whole well mixed up. The mass, before it is used, is suffered to remain until it has partially set, which will require from twelve to thirty-six hours, according to the quality of the mortar. This delay is found to improve the quality of the concrete. This material depends on the quality of the mortar for its excellence. It is not stronger than simple hydraulic mortar, but it is far more economical. The gravel, which enters into its composition, is used to fill up the voids between the fragments of stone, which would otherwise be filled by the mortar alone. Broken brick may be used instead of fragments of stone when the latter cannot be had; or gravel alone may be used.

CONCRETION. See CALCULUS.

CONDITION. Healthiness, strength, energy, and fine appearance in a horse. Condition implies not merely plumpness and sleekness, but such a degree of high, healthy vigour as enables the animal to perform extraordinary labour with-

out becoming over-fatigued. Every defect with respect to condition originates either in bad grooming or in disease.

CONDUCTOR OF LIGHTNING. An instrument, by means of which either the electricity of the clouds—the cause of lightning—is conducted, without explosion, into the earth, or the lightning itself is intercepted and conducted, in a particular way, into the earth or water, without injuring buildings, ships, &c. This invention belongs to Franklin. While making experiments on electricity, he observed that a pointed metallic wire, if brought near an electrified body, gradually deprives the latter of its electricity in such a manner that no sparks appear. Therefore, as clouds are electrified, he thought that they might be deprived of their electricity (which is the cause of lightning and of its striking), if a pointed metallic rod were fastened upon the highest part of a building, and a wire carried down from this into the earth, so that the electricity of the cloud, attracted by the point, might be conducted into the ground. Franklin's conjecture proved to be well founded, and conductors were soon after introduced into many countries. They at first consisted of an iron rod, running down the sides of a building into the earth, while its point rose several feet above the building. Experience, thus far, shows the best construction of conductors to be this:—The conductor consists of a rod of iron, an inch thick, to the upper end of which is attached a tapering piece of copper, 8 or 9 inches in length, gilded, to prevent its rusting. This rod is fixed to the highest part of a building, in such a way as to rise at least 5 or 6 feet above it: to this are fastened strips of copper, 3 or 4 inches broad, and riveted together, which must reach to the earth, and be carried into it about a foot deep. The strips are to be carefully nailed upon the roof and against the wall of the building. The first conductors in Europe were erected at Payneshill, in England, in 1762, and upon the steeple of St. James' church, at Hamburg, in Germany, in 1769. In modern times, conductors have been proposed to supersede those formerly in use. Among them is the cheap one of Nicolai, made of strips of tin, which has already been used; for instance, at Lohmen, near Pirna. Millington says, "No rod of iron less than $\frac{3}{4}$ of an inch in diameter, should be used, but an inch will be better. Both the upper and lower ends should terminate in sharp points, because electricity is known to enter and to leave points with less violence than any other shape; and as the upper point, from its constant exposure to all weathers, soon decays, and is sometimes melted by a stroke of lightning, it is best to protect it by forming it of some good conducting substance that is nearly imperishable, and charcoal, solid plumbago or black-lead, and the metal platinum, are best suited to this purpose, the last being the best; and as the quantity of platinum is not necessarily large, the expense

is not great. As lightning rods cannot be procured of sufficient length in one piece, the separate rods ought to be welded together if of iron, or one length may be screwed into another, which method is usually adopted with copper rods: and when they are made of iron, (that metal being usually selected on account of its cheapness,) the lower termination, and about three or four feet above the ground should be made of copper, to prevent the decay and dangerous consequences that might attend the lower end being rusted away and deficient. Perfect continuity of the metallic rod is of the highest importance; for lightning never does damage, except when it strikes an imperfect conductor, or has to jump or pass from one conducting substance to another. If a building is unprotected by a metal rod, and happens to be struck by a flash, it is generally found that the lightning first strikes and melts any lead, copper, iron, or other metal that is in the roof, even to the nails; from thence it finds its way to bell-wires, the silvering of looking-glasses, fire-grates, locks, bolts, hinges, or other articles of metal that may be distributed about the place, and if these are separated by dry timber, brick or stone work, through which the lightning must force its way, it never fails to break them asunder or shatter them to pieces, because it is in the effort to get from one conductor to another that it exerts its violence."

CONFECTION. A preparation of fresh vegetable matter with refined sugar. In the sense of a condiment, prepared either by the domestic cook or the professional confectioner, it must be understood to have wide limits; but in the sense of a pharmaceutical preparation, manufactured by druggists or by similar parties, it must be understood as synonymous with a conserve, or as an uniform, beaten-up mass of sugar and such fine portions of plants as petals, fruits, and juices. A pharmaceutical confection possesses little medicinal power, yet is an easy, agreeable, and useful medium of the exhibition of more active substances. About a dozen different kinds of confections are ordered by the pharmacopeias.

CONFERVÆ. A large, curious, and extensively diffused group of cryptogamous plants, of the algæ order. The proper confervæ are simple, tubular, jointed algæ, floating on the water of ditches, pools, bogs, springs, rivers, salt marshes, and the borders of the sea. About 60 species are enumerated as inhabiting Britain; and about 80 other species have been described. See the article **ALGÆ**.

CONGLOMERATE. A kind of rock consisting of water-worn stones and fragments of prior rocks held together by a cement. It is popularly called pudding-stone. It belongs geognostically to any kind of sandstone formation, but is particularly abundant in the old red sandstone formation; and it may be regarded as holding the same relation to ordinary sandstones which gravel holds to ordinary sands. Its embedded stones and

rounded fragments may be of any size, from the largest masses which are transportable by the streams of rivers to the smallest pieces which can be pronounced distinct from the granules of sandstone; and its cementing matter may bear any proportion to the embedded stones and fragments, from a quantity composing much the larger part of the whole rock, to a quantity barely sufficient to hold the stones and fragments together. Rock whose embedded stones are all truly water-worn constitutes true conglomerate; and rocks whose embedded fragments are angular and edgy, and afford indications rather of the violent explosive action of a volcano than of the gentle wearing action of an aqueous current, constitute breccia. Conglomerate, on a large scale, is at present in the course of formation at the mouths of some of the rivers which drain the Italian side of the Alps.

CONIFERÆ. A large and most important natural order of dendritic plants. The name *coniferæ* means cone-bearing, and alludes to the general conical form of their gymnospermous fruit. This fruit or "cone," encloses the naked seed, and exhibits a number of scales, collected into a conical outline. The scales, in some instances, as in the pine, are hard and long; in others, as in the larch, are thin; and in others, as in the juniper, are so succulent and compressed as to give the cone the appearance and the popular reputation of a berry. All the *coniferæ* secrete a terebintaceous sap; and they collectively sustain the same kind of relation to all the resinous trees of the world, which the *amentaceæ* bear to the non-resinous trees. Their wood consists of tubular vessels of nearly uniform diameter, with occasional fistular cavities, for receiving and containing the resinous secretions. Their branches are produced from numerous buds on all sides of the stem. Their leaves, in many instances, are strictly needle-shaped, and, in most, are linear, veinless, and sharp-pointed; but, in some instances, as in *Salisburia adiantifolia* and *Podocarpus aspleniifolia*, they are broad and curiously shaped, and have the same kind of veining as the fronds of ferns.

Coniferæ, in the present state of our knowledge and classification of them, comprise 18 genera, and have, within Great Britain, about 112 hardy species, about 30 half-tender or doubtfully hardy species, and 6 or 7 decidedly tender species. All are trees or shrubs; most are extensively diffused and exceedingly important forest trees; and some are among the tallest and most voluminous trees in the world. Three of the genera, the yew, the cypress, and the spruce fir, have been selected as types of subdivisions of the order,—hence called *Taxinæ*, *Cupressinæ*, and *Abietinæ*. The genera of the *taxinæ* are *taxus*, *podocarpus*, *schubertia*, and *ephedra*; those of the *cupressinæ* are *cupressus*, *thuja*, *juniperus*, *callitris*, and *dacrydium*; and those of the *abietinæ* are *abies*, *picea*, *larix*, *cedrus*, *pinus*, *auracaria*, *altingia*, *cunninghamia*,

and dammara. Most of the order, particularly the numerous pines, the numerous firs, the yews, the cypresses, and the arbor vitæ, are inhabitants of the northern parts of the world; and many of these constitute immense forests, while some grow wild and afford shelter and profit in situations too alpine, sterile, or frigid to be occupied by any other kind of trees. The greater number are evergreens, and afford, by means of their hard, persistent, linear foliage, a hybernal protection amidst snows and tempests which would speedily exterminate the more showy evergreens of the south.

The timber of numerous kinds of coniferæ, under the names of fir, pine, deal, memel, red cedar, sandarach wood, and other designations, is most extensively used in building and in many other arts, and forms a large proportion of the timber of commerce. The resins and terebinthaceous juices of many species constitute the pitch, turpentine, Canada balsam, and some other similar substances so extensively used in the arts, and occasionally in medicine. The seeds of all are oily; and those of four or five species are eatable; but those of the yew are poisonous. A number of species have been very extensively and most advantageously employed in the formation of the modern plantations of Britain,—particularly in those of moorland and mountainous districts; and very many of the species form fine ornaments of the park, and contribute largely to the achievements of landscape-gardening; while a few, such as the auracarias, the altingias, the cunninghamias, *Salisburya adiantifolia*, and some of the rare and curious pines, are worthy of a prominent place in a select and sheltered shrubbery or in the conservatory and the greenhouse.

CONIUM. See HEMLOCK and ARACACHA.

CONNARUS. A genus of ornamental, evergreen, tropical shrubs, of the terebinth order. Three species of it, the paniced, the shining, and the pubescent, were introduced about 20 or 25 years ago to Britain; and four other species have been described. They have pinnated, alternate, unstipulate leaves, and polypetalous, white-coloured, ten-stamened flowers; and their seeds possess the singular character of having the embryo at the remote end from the hilum. Three genera of terebinthaceæ,—connarus, cnestis, and omphalobium—are usually classed together as a tribe under the name of Connaraceæ.

CONOCARPUS. See BUTTON-TREE.

CONSERVATORY. A glazed structure for the hybernal or constant protection of tender or half-tender exotic plants. It has a great variety of form and destination; but, in general, may be regarded as in principle the same thing for large plants which a greenhouse is for small ones. See the article GREENHOUSE.

CONSERVE. See CONFECTION.

CONSTIPATION. An animal's undue retention or imperfect evacuation of the fæces. See the article COSTIVENESS.

CONSUMPTION,—scientifically *Phthisis pulmonalis*. A well-known fatal disease of the lungs of animals. It is not very uncommon in the horse. It occurs in that animal, sometimes as a primary or constitutional affection, but more generally as a consequence of bronchitis, pleurisy, or pneumonia. A horse, when attacked with it, contracts a short, dry cough, loses the glossiness and fine condition of his coat, and becomes easily fatigued by exertion. His pulse at first is but little affected, but afterwards becomes quickened, comparatively small, and very easy of acceleration. He gradually loses appetite, afterwards emits from the nose a mixture of pus and mucus, and eventually emits from both nose and mouth, when coughing, a mixture of pus, mucus, and coagulum. In the advanced stages of the disease, the purulent and clotty discharge is fetid, the hair falls off, and the whole body is emaciated; and at last, the animal either sinks under the hectic irritation or is suffocated by accumulations of the coagulum and pus. The virus of the disease is a tuberculated state of the lungs; in its early stages, the tubercles are hard, and appear, on dissection, like small hardened masses in the parenchyma of the lungs; but, in its progress, they soften, secrete pus, erode the walls of the lungs, spread out into ulcers and abscesses, and consume piece by piece the substance of the organ, till either enough is not left for the vital discharge of the pulmonic function, or suffocation takes place in consequence of the purulent discharge. Various treatment for the cure of the disease has been recommended; but the best requires to be practised before the disease is far gone, and can never restore the animal to a sound or really healthy condition. Consumption, in fact, either invariably kills the horse, or, when seemingly palliated or cured, renders him unfit for the objects of his existence as a working animal; so that, in an economical view, it is strictly incurable.

Consumption in cattle is frequently contracted from a cause against which all farmers ought to be on their guard,—hereditary predisposition; and, as in horses, it is often contracted also as a consequence of bronchitis, pneumonia, and other affections of the chest. It sometimes exists for a considerable period without indicating itself by any arresting symptom; and it frequently exhibits only such symptoms as unpractised observers are unable to distinguish from the symptoms of pleurisy, or even from those of pneumonia or bronchitis. The earliest decided symptom, and indeed the guiding symptom even in an advanced stage and in relapses, is a weak, hoarse, hollow, painful, gurgling cough, of so peculiar a character as to challenge for itself the epithet phthisical. "It is too common," remarks Mr. Youatt, "to say carelessly, and sometimes cruelly, of a human being, 'That person has a church-yard cough.' The prediction is too often verified; for although it would be difficult to describe that cough, there is a character of its own about

it which cannot be mistaken. It is so with regard to cattle. That veterinary surgeon is ignorant of his profession, who does not at once, and at a distance, recognise the cough which, although it may not precisely indicate phthisis, betrays a state of the lungs pregnant with danger. How many a beast might the farmer save if he would be attentive to this! A bullock hooses: if the cough is sonorous and clear, the lung is not yet fatally injured. That cough, however, must not be neglected long. It tells of inflammation; it is the product of inflammation,—and of inflammation that may be silently, but rapidly, disorganizing the lungs. The prudent man will not suffer such a cough to continue many days without giving a mash or a dose of physic, or perchance bleeding and inserting a seton." Yet soundly economical conduct in reference to phthisis in cattle, is either to prevent it, or, instantly on its detection, to commence fattening the subject of it for the shambles. An ox or a cow, in the merely initial stages of consumption, will fatten almost as rapidly and perhaps quite as soundly as if every organ were in perfect health; and many an animal on being killed and cut up by the butcher, proves to have lost, from erosive waste, a large portion of its lungs. To save a phthisical beast, therefore, is rather to prevent the loss of its market value, than to protect or prolong its life.

Consumption in sheep is exceedingly frequent; but, in an economical sense, is vastly better understood than consumption in cattle. The earliest indication of consumption in sheep is very generally made the occasion of killing the animal or sending it to the butcher; so that the disease is seldom seen in its advanced stages or in a fully developed condition. The usual treatment of sheep, when suffering catarrh, is very bad, and entails diseases of the lungs upon a far larger proportion of flocks than is commonly imagined. A sheep with a recently contracted cough loses neither flesh nor appetite, and is therefore treated as if he were in perfect health; he continues to be exposed to wet and cold; he is shorn at the same time as the rest of the flock, without regard to either the weather or his own disorder; and he, in consequence, passes almost as certainly and rapidly into consumption as if his shepherd had intended to inflict the disease. Let a more rational method be practised; let a sheep, on contracting a cold, be removed to a sheltered situation; let him, if the symptoms be violent, receive all the aids to recovery which his shepherd can afford; and if afterwards, and in spite of this, he exhibit symptoms of consumption, let him with all speed be devoted to slaughter. See the article CATARRH.—*Blaine's Veterinary Art.*—*Bartlett's Farriery.*—*Youatt on the Horse.*—*Clater's Cattle Doctor.*—*Journal of the Royal Agricultural Society.*—*White's Veterinary.*—*Youatt on Cattle.*

CONSUMPTION. The gradual enfeeblement and eventual wasting away and death of a plant.

This must be viewed less as any one disease, than as the common or aggregate character of a number of diseases. It originates variously in too frequent and profuse flowering, in bad planting, in mechanical damage to the roots, in poverty of soil, in excessive drought, in severe and sudden vicissitudes of weather, in unusually tempestuous winds, and probably in some other causes equally distinct; and it may be supposed to have a variety in its modes of action or in its distinctive nosological characters corresponding to the variety of these causes. The preventive of most kinds of it is manifestly good culture.

CONTORTION. The effect of the injury inflicted on the leaves of plants by the puncture of insects, particularly of the aphidea. The leaves of the peach, the apricot, the nectarine, and the apple-tree, are very liable to contortion. The only sure preventive of the evil is to destroy the little creatures which cause it. See the articles APHIS and INSECT.

CONTRACT. An agreement or covenant between two or more persons, in which each party binds himself to do or forbear some act, and each acquires a right to what the other promises. Natural law requires that if one person accepts from another a service, he should render to him something in return, whether this be expressly agreed upon, or only implied from the nature of the undertaking. Mutual promises of future good offices also are binding, at least by the natural law, if one of the contracting parties has thereby been induced to act; for, if he does not receive the thing stipulated for, he suffers wrong. We may go further, and say, that confidence in promises is so essential to the existence of social intercourse among men, that even the bare promise of one of the parties, when given and received in earnest, that is, with the idea of its being binding, is not entirely destitute of the force of obligation. In every state, it will be necessary to retain these principles, since the idea of justice implanted in the human mind should not be violated. It is the part of legislation to provide for special cases, to establish certain forms, and to fix, according to rules founded upon experience, the effects of each promise; also to withdraw from certain contracts their natural obligation, or to determine this in others, in which it is uncertain according to natural law. Such has been the course of the Roman law, which, by its consistency and justice in regard to contracts, has obtained, on the continent of Europe, almost universal authority. In that law, at an early period, a contract in the proper sense of the word, was an agreement binding on both parties. It was required to be in a determinate form; and there was an equally determinate mode of impeaching it. A contract was distinguished from a simple pact or promise; and it was a fundamental doctrine, that a simple pact would not entitle one to maintain a legal action, but merely to raise an objection in defence. The

essential character of contracts in the strictest sense, is founded on the circumstance that such a legal relation is necessary for the most simple social intercourse, and imposes, according to its nature, certain duties. The most simple of these relations arise from a positive act, as the transfer of a thing to be returned, in which the object and extent of the obligation are determined by the real benefit conferred. Such a contract arises from delivering a thing, with or without pay; as, for instance, a deposit or a pawn. A determinate form of agreement, however, is not always necessary. Civil intercourse allows another kind of contracts, in which the simple consent of the parties gives obligation to agreements, so that they may constitute the ground of an action. Such, according to the Roman law, is sale, hire (as well as the lending of a thing as services done for money), partnership, an accepted commission, and the contract for a fee farm rent. To the conditions necessary for the formation of a contract belongs the consent of the contracting parties. Accordingly, when this is wanting, either because the parties were not capable of taking upon themselves the obligation (as minors, madmen, prodigals), or because the contract was founded on an error (an innocent error on the side of the party making the mistake, or one occasioned by the deceit of the other party), or when the engagement was extorted by force and fear, there can be no valid contract. To contracts may also be added conditions, which either delay or dissolve them, and also precise determinations of time, place, and object, which coincide, at times, with the condition. A contract must be possible and legal, else it is without force. No one can be obliged to undertake what is impossible, or decidedly immoral. According to the Roman law, it is a matter of dispute, whether an obligation to do something or to leave something undone gives a right to compel a specific performance, or whether it gives merely a claim to indemnification. The English and French laws have adopted the latter doctrine. Obligations resembling express contracts arise if one person does something for another, without the knowledge and desire of the latter; so that the latter is bound to give a recompense for what has been thus beneficially done for him. In this case, there is no consent existing, neither is it supposed, but the consent could not have been refused, or it was not necessary. Such relations, resembling express contracts, arise in cases of guardianship, between guardian and ward, by the receipt of money for a non-existing debt by mistake, the amount of which ought to be restored; so by a beneficial performance of some business for another, without any actual commission from him, where the circumstances raise a presumption of obligation.

Thus far the present article refers to the general theory of contracts, founded either upon natural justice or the principles of the civil and

Roman law. A short account will now be added of the nature and obligation of contracts by the common law; that is, by the law which regulates this subject in the jurisprudence of England and Scotland. The original basis of the common law, as to contracts, was, without doubt, the civil or Roman law; but it has undergone some modifications in its incorporation into our jurisprudence. A contract may be defined, in the common law, to be an agreement made in one form, between parties capable of contracting, for a legal object or purpose, and upon a sufficient consideration. It must be an agreement or mutual bargain, voluntary, and without force or fraud; and therefore it includes an assent given *bona fide*. The notion of an assent includes a physical and moral power of assenting, and the deliberate and free use of this power. And this leads us to the consideration of the next point, which is, that it must be between parties capable of contracting. Upon principles of universal law, an infant, having no discretion or moral power of perception, cannot make a contract; nor can a person who is insane or mad; nor an idiot, or person labouring under such mental debility or such natural defects as prevent a just exercise of reason. The common law recognises these principles, and therefore it treats as nullities all contracts entered into by such persons; it treats in like manner contracts made by aged and imbecile men, whose understanding has become so weak and inefficient that they are liable to imposition, and cannot act with a reasonable discretion. In respect to persons who enter into contracts in a state of intoxication, the old law, with a view to deter men from such practices, did not hold the contracts void, so that the party might set them aside at his own suit, upon the ground that no man should be allowed to stultify himself, or allege his own vice to excuse his non-performance of a contract. But this principle, if it is now acted upon at all, is received with great modifications; and, if there be any undue advantage taken of the party's situation, he will be relieved. The common law indeed seems originally to have disabled a party who was insane from avoiding, after the recovery of his reason, any contract made during his insanity; partly upon the maxim that no man should be permitted to stultify himself, and partly upon the supposed danger, in admitting such defences, of overturning deliberate and solemn contracts. But his legal representatives, after his death, were always allowed to avoid them; and when he has a guardian appointed, the guardian may avoid his contracts in a proper suit; so that the doctrine, if it now exists (and it has been much questioned), is more a matter of form than of substance. In respect to who shall be deemed infants or minors, the laws of every civilized country have provided a certain age, at which persons shall be deemed capable of all sorts of contracts, and for all purposes *sui juris*. The time differs in different

countries, and different times are assigned for different acts. By the common law, all persons are infants until twenty-one years of age, and then are considered as of full age for all purposes whatsoever. By the same law, the ages of males and females are different for different purposes. A male at fourteen is at years of discretion, and may consent or disagree to marriage, may choose his guardian, and, if his discretion is actually proved, he may make a testament of his personal estate, though not of his lands; at seventeen, he may be an executor. A female may, at seven years, be betrothed in marriage; at nine, is entitled to a dower; at twelve, may consent or agree to marriage; at fourteen, may choose a guardian; at seventeen, may be an executrix; and at twenty-one, is of full age for all purposes. Both males and females are capable of making contracts for necessities during their minority; but, in general, other contracts do not bind them, unless manifestly for their benefit; and, though contracts made with them cannot be avoided by the other side, the infants themselves, when they arrive at age, may ratify them; for, as to them, they are generally voidable, and not void. A contract, too, must be for some legal object or purpose; that is, for something which the law allows to be done or omitted; for it is a general principle, that all contracts which are prohibited by law, whether they involve moral turpitude, or are merely prohibited by positive law, are void and incapable of binding the parties. A contract, too, must have a sufficient consideration to support it. Considerations are either valuable in themselves, or good. A good consideration is such as flows from blood or natural affection between near relations, such as parent and child. In respect to such considerations, it may be said, that they are, as between the parties, generally sufficient to support an executed contract; that is, a contract which has completed its operation by a transfer of the thing, such as a gift or grant, or assignment and delivery of a thing. But where the rights of third persons, such as creditors, intervene, such gifts, or grants, or assignments, are not always valid, as against them. For a man must be just before he is generous. But in respect to good considerations, if the contract is not executed, but is a mere chose in action, such as a promise to pay money, or to deliver goods, or to give a thing, such a contract has no legal obligation, and cannot be enforced in a suit, in a court of law. It is generally deemed a voluntary promise or naked pact. A valuable consideration is one arising from, or on account of, money or goods received, or services done, or other contracts of reciprocal benefit, or marriage, or a loss or injury, or forbearance of right. In all such cases, if a promise is made on any of these or the like accounts, it is binding in law. If A promises to pay ten dollars to B for goods sold to A, or money borrowed, &c., it is a binding contract. So if A promises to pay B a debt due

from C, if B will forbear, for a certain time, to sue C, it is a binding contract. So, if A has done an injury to B's lands or goods, and promises to indemnify him, it is a good contract. In all these cases, there is a mutuality of interest or consideration—a *quid pro quo*. But a mere moral obligation creates no contract; as if A promises to give a pauper his clothes, or to supply him with necessities. But though, in general, a contract is not binding, unless made upon a valuable consideration, there are certain forms in the common law, as there are in the civil law, by which a party may bind himself without such consideration. If, therefore, A enter into a written contract, under his seal, with B, to pay him a sum of money, or do any other act, there the common law considers the deed of such high solemnity, that it will hold it binding. It deems it as importing a valuable consideration, or rather will not suffer the contrary to be proved, and acts upon the solemnity of the instrument as, of itself, of paramount obligation. There are certain contracts which the common law requires to be done in a particular mode to give them validity, and therefore another requisite is, that the contract must be in due form. There are certain things, which can be conveyed or transferred only by some written instrument or deed, such as incorporeal hereditaments, as rights of ways, easements, &c.; and, generally speaking, lands can now be granted only by deed. There are also many cases specially provided for by statutes, in which contracts are not binding, unless reduced to writing, and signed by the party or his agent. Among these are contracts for the debts of another, contracts respecting lands, and contracts respecting goods beyond a certain value. Indeed, many of the regulations, here referred to as part of the common law, are variously modified by the local jurisprudence, and principally by statutes.

CONTRACTS FOR WORKS. The usual course of proceeding, when contractors for work can be obtained, is for the engineer to prepare his map or plan of the country, together with a correct profile or section to scale, of the intended work, and to write out a specification or particular explanatory of his drawings and plans, stating how the work is to be executed, where it is to begin,—pointing out where the spare soil or rubbish, or material to be removed, is to be deposited,—when the work is to commence,—what time will be allowed for its completion,—how and where it is to be paid for,—what penalty is expected to be incurred should the work be slighted, neglected, or not finished within the stated time,—whether the contractor is to be kept free from water should springs be cut into in the progress of his operations, or whether he is to bear his own carriages or water-charges,—and any other particulars necessary to be known. These plans and particulars are then deposited in some accessible place, as near as possible to where the work is to be performed, or in a neighbouring town or

city. Advertisements are then inserted in newspapers, or otherwise brought before the notice of the public, stating that certain works are required to be done, the plans and particulars of which are deposited for inspection and examination at a certain place, from some specified date to another, and inviting all persons who may be willing to contract for the execution of such work, to inspect the plans, or the ground itself, and to send in sealed tenders to a certain place, on or before a certain day; in which they are to state the price or conditions upon which they will undertake the performance of the work. These tenders are opened by a committee or some authorized person, and the common course is to let, or give the work to the lowest bidder. Notwithstanding this is the usual practice, it is one that ought not to be universally adopted, because the ability of the contractor to perform the work, and his responsibility ought always to be inquired into. Many instances occur in which parties, from the hope of gain, will put in tenders, without being acquainted with the nature of the work, and will take contracts for its performance at prices lower than it can possibly be done for, although they perhaps neither possess the necessary implements, or capital to pay their men, or provide what is necessary for its execution; and, notwithstanding they may give sureties under bond for the due performance of what they undertake, yet when they find it costs more than they are to receive for it, or that their operations are so unsatisfactory to the engineer that he will not pass their accounts for payment, abscond, leaving their sureties to suffer, or prove that they are not responsible; the engineer has then to look out for other persons to finish his work, after much delay and vexation, and perhaps can only procure them at very advanced prices. The engineer, from his knowledge and experience, ought to be able to judge of the value of what he means to execute, and should be consulted as to the tenders before any one is accepted; and he ought not to permit any tender to be accepted when he knows the price offered is such a one as will not allow the work to be executed in a good and substantial manner. Cases do sometimes occur, and the author has met with them, in which able and competent contractors having a heavy stock of materials and horses, and powerful gangs of men, whose operations may have met with temporary suspension from unavoidable causes, undertake to do jobs at very low prices through competition, rather than break up their establishments, and dispose of their stock; and in such cases, if the contractor is known to be capable and responsible, of course the engineer is bound to give his employer the advantage arising from the circumstances; but in general he cannot be too careful about the character and responsibility of his contractor. Persons who undertake large contracts for earth-work, as well as their workmen, have obtained the name of

Navigators, from the circumstance of their work having in general some connexion with the formation of inland canals, docks, and rivers, or other accessories to navigation.—*Millington*.

CONTRAJERVA,—botanically *Dorstenia Contrajerva*. A tender, evergreen, medicinal, herbaceous plant, of the nettle tribe. It is a native of Peru, Mexico, and the West Indies, and was introduced to the hothouses of Britain about the middle of last century. Its root is fusiform, knotty, branching, brown without, and whitish within; its leaves are radical, petiolate, about four inches long, about four inches broad, irregular-shaped, and deeply lacinated; and its fructification is produced on radical stalks or scapes about 4 or 6 inches high, and comprises a fleshy, placenta-like receptacle, about an inch long, and three-fourths of an inch broad, and a number of very small, green, scarcely conspicuous flowers, packed closely together, and covering the whole disc of the receptacle. The root is the part used in medicine; it retains its virtues when dried and pulverized, and surrenders them to either alcohol or water; it has a warm, bitterish taste, and acts as a sudorific and a tonic; and it is employed in chronic rheumatism, atonic gout, dysentery, difficult dentition, and several kinds of fevers.—*Contrajerva* or *Contrayerba* is also the name of a tender, medicinal, biennial plant, of the sunflower division of the composite order. This plant is called by some botanists *Flavaria Contrayerba*, and by others *Millaria Contrayerba*. It was introduced to Britain from Peru, near the close of last century. It has a height of about 20 inches, and carries a yellow flower in the latter part of summer and early part of autumn.

CONTUSION. See **BRUISE**.

CONVALLARIA. See **LILY OF THE VALLEY**.

CONVOLVULUS. See **BINDWEED**.

CONVEYANCE, in law. The transfer of the title to lands or hereditaments. There are different kinds of conveyance at common law; as by feoffment and livery, that is, making a deed of the land in fee, and putting the grantee into possession; by lease and release, that is, granting a term of years, or other limited right of possession of the land, and then relinquishing the remainder to the lessee, after he has taken possession; by grant, which was first used in regard to incorporeal hereditament, such as the right of receiving a certain perpetual rent, or appointing a clergyman to a particular church, where no livery of seizin and actual possession could be given, but was subsequently applied to corporeal hereditaments; or, finally, by bargain and sale, which is, in fact, a species of grant. Such were the modes of conveyance by the common law; but the introduction of uses and trusts made a great revolution in the modes of conveyance in England. The feoffment to uses was first introduced, whereby the fee of the land was granted to one person, for the use or benefit of another. The statute of 27^o Henry VIII., was passed to prevent this

species of conveyance, by enacting, that, where it was made, the fee should pass to the person for whose benefit the grant was made, so that the effect should be the same as if the conveyance had been made to him directly. To evade this statute trusts were invented, whereby the land was conveyed to one, for the use of another, in trust for a third; and the courts, favouring this evasion of the statute, held that, in such case, the fee would pass to the second, to be held for the use and benefit of the third; thus effecting, by the intervention of another party to the conveyance, what the statute was intended to prevent. This contrivance has rendered the system of conveyancing very intricate and complicated in England.

CONYZA. See FLEABANE.

COOP. A pen, or small covered enclosure, for confining and feeding poultry, lambs, or other small domestic animals; also a cart or tumbrel so enclosed as to retain the particles of sand, grain, or any similarly formed material.

COPAIBA, or CAPIVI,—botanically *Copaifera*. A genus of balsamiferous, medicinal, evergreen, tropical trees, of the *cæsalpinia* division of the leguminous order. Two species, *C. officinalis* and *C. guianensis*, have been introduced to British hothouses; and twelve other species have been described. Almost all the species yield the copaiba balsam of the drug-shop; a species called *C. multijuga*, which grows wild in Para, yields it in largest quantity; and the officinal species, on account of its being best known in Britain, may be briefly noticed as the most suitable specimen of the genus. *C. officinalis* is a native of the Spanish West Indies and tropical South America; it particularly abounds in the woods of Carthage and of some parts of Brazil; and it was introduced to Britain in 1774. Its stem is clothed with a brownish, ash-coloured bark, branches at the top, and usually attains a height of about 30 feet; its leaves are pinnated and large, and consist of four pairs of folioles and a terminating odd one; its folioles are petiolate, alternate, ovate, pointed, ferruginous, entire, shining, and two or three inches long; its flowers have a white colour, and are produced in stiff, spreading, terminal racemes; and its pods are oval and two-valved, each containing a single egg-shaped seed. The copaiba balsam of commerce is obtained by wounding or boring the trees to the pith; it flows out clear and limpid, and afterwards becomes thickish and yellowish by keeping; and it is imported from Brazil to Britain in small casks. When genuine, it has a hot, bitterish, nauseous taste, a peculiar but agreeable odour, and a pale golden yellow colour; and when kept well corked in bottles, it has the consistency of a thickish oil, but when exposed in a somewhat thin stratum to the air, it gradually becomes as dry, solid, and brittle as resin. In chemical constitution, it has a much closer relation to the turpentine than to most of the balsams. But it is ex-

ceedingly often adulterated with rape oil, with castor oil, or with a mixture of oil and mastic, and cannot, without difficulty, be obtained genuine. Copaiba balsam is diuretic, stimulating, and gently aperient; it is serviceable in hæmorrhoidal affections, and has been recommended in pulmonary complaints; and it is very extensively employed in several diseases of the generative organs. It might be of much service as a cattle medicine; but is hindered from coming into general use by its dearth and its very frequent adulteration. In cases where it ought to be employed, most veterinary surgeons use some common diuretic.

COPAL. A remarkable resin, extensively used in the arts. It is the produce of a hardy, deciduous, ornamental shrub, of the sumach genus, —*Rhus copallina*. This shrub is a native of North America, and was introduced to Britain in the latter part of the 17th century. Its stem and branches are covered with a smooth brown bark, and usually attain a height of about 6 feet; its leaves are pinnated, beautifully arranged, and most handsome in appearance,—each having four or five pairs of folioles, a terminating lentiscular odd one, and a membrane or wing on each side of the folioles running from pair to pair; its folioles are small, green, and shining; and its flowers have a greenish-yellow colour, grow in large loose panicles, appear in August and September, and make but an inconspicuous figure. The resin obtained from this shrub exists in smooth, brittle, translucent, roundish, small masses, has little taste and scarcely any odour, is fusible by heat, inflammable by ignition, insoluble in water, very sparingly soluble in alcohol, and fully soluble in sulphuric ether and some essential oils. It is the characteristic ingredient of the well-known copal varnish,—an article requiring operose and careful manufacture, but distinguished for the brilliance, durability, hardness, and resistance of its exquisite polish.

COPPER. A well-known metal, of a red colour, with a tinge of yellow, having considerable lustre, but liable to tarnish and rust from exposure to the air. It is moderately hard, and has considerable ductility and malleability. Its specific gravity is 8.78. It has a sensible odour, especially when heated or rubbed, a styptic, unpleasant taste, and is peculiarly poisonous to animals. Copper melts at a full white heat, and, by slow cooling, may be crystallized. It suffers oxidation at a lower temperature from the action of the air, thin scales of oxide forming on its surface when it is heated to redness. At a higher heat, it burns with a green flame. Exposure to air and humidity, at the natural temperatures, converts it into a green rust, which is the oxide combined with a portion of carbonic acid.

There are two oxides of copper. The protoxide is of a red colour, and occurs native, in the form of octoedral crystals, in the mines of Cornwall. It is also prepared artificially, by mixing 64 parts

of metallic copper, in a state of fine division, with 80 parts of the peroxide, and heating the mixture to redness in a close vessel; or by boiling a solution of the acetate of copper with sugar, when the peroxide is gradually deoxidized, and subsides as a red powder. It consists of one atom, or proportional, of copper, 64, and one of oxygen, 8, = 72. The sulphuric, muriatic, and probably several other acids, form with it salts, which, for the most part, are colourless. On exposure to the air, they attract oxygen, and are rapidly converted into per-salts. The peroxide of copper is also found native, and may be prepared artificially by calcining metallic copper, by precipitation from the per-salts of copper, by means of pure potash, or by heating the nitrate of copper to redness. It is composed of one atom of copper, 64, and two of oxygen, 16, = 80. It varies in colour from a dark-brown to a bluish-black, is insoluble in water, and does not affect the vegetable blue colours. It undergoes no change by heat alone, but is readily reduced to the metallic state by heat and combustible matter. It combines with nearly all the acids, and most of its salts have a green or blue tint. It is soluble, likewise, in ammonia, forming with it a deep blue solution—a property by which the peroxide of copper is distinguishable from all other substances. Metallic copper is oxidated and dissolved by the greater number of the acids, and forms with them, in general, soluble and crystallizable salts. Sulphuric acid, either concentrated or diluted, oxidates it, and combines with the peroxide, especially when assisted by heat. The solution is of a blue colour, and, when evaporated, affords crystals in the form of rhomboidal prisms. This salt is the *blue vitriol* of commerce, and is usually obtained, either by evaporation of the solution of it, formed by the infiltration of water through copper mines, or by exposure of sulphuret of copper to the action of air and humidity, until the sulphur is converted into sulphuric acid, and the metal is oxidated and combined with it. Nitric acid acts on copper with great energy, the metal attracting a portion of its oxygen, nitric oxide gas being disengaged, and the oxide combining with the remaining acid. The solution, when evaporated, affords prismatic crystals, of a deep green colour, deliquescent, and easily soluble in water. From the facility with which it parts with oxygen, it acts with energy on several substances. Thus it detonates when struck with phosphorus, and it burns several of the metals. If wrapped in tinfoil, the tin is oxidated with such rapidity as to be attended with inflammation. Muriatic acid dissolves copper slowly, when the air is admitted: if it is excluded, the action is very inconsiderable, unless heat is applied. The solution is of a fine green colour, and, by evaporation, slender prismatic crystals are obtained, which are deliquescent, and very soluble in water. The combinations of peroxide of copper with phosphoric, carbonic, and other

acids, are effected by adding to a solution of nitrate or sulphate of copper a solution of a neutral salt, containing the acid with which the copper is designed to be combined. Copper is slowly oxidated by a number of weaker acids, as by some vegetable juices, when acted on by them with the admission of air. Acetic acid, or vinegar, in particular, forms an important compound with the oxide of copper. To obtain it, copper plates are exposed to the fumes of vinegar. A crust is soon formed of a green colour, which is the *verdigris* of commerce.

All the salts of copper are decomposed by the alkalies and earths. Potash, soda, and the alkaline earths, throw down precipitates, which are of various shades of green or blue, according to the quantity of alkali added, the colour being green if a small quantity is added, and becoming blue from a larger quantity. These precipitates are sub-salts, the alkali attracting the greater portion of the acid, but the oxide precipitated still retaining a portion of the acid combined with it. The action of ammonia upon the salts of copper is more remarkable. It first abstracts a portion of the acid, and throws down a green or blue precipitate, which is a sub-salt; but, when added in larger quantity, it redissolves this precipitate, and forms a transparent solution of a very deep-blue colour, which, when evaporated, affords fine blue crystals. A triple compound, used in medicine under the name of *ammoniuret of copper*, is prepared by triturating together two parts of sulphate of copper with one part of carbonate of ammonia, the mass becoming soft from the mutual action of the two salts, the carbonic acid being disengaged with effervescence, and the triple compound of sulphuric acid, oxide of copper, and ammonia, being obtained of a deep violet-blue colour. Copper is precipitated in its metallic state, from its saline solutions, by zinc and iron; either of these metals attracting the oxygen which serves as the medium of its union with the acid of the solution. Its oxide is precipitated by albumen, and the precipitate is almost inert; hence the whites of eggs have been recommended as an antidote to the poisonous salts of copper.—The best mode of detecting copper, when suspected to be present in mixed fluids, is by sulphuretted hydrogen. The sulphuret, after being collected, should be placed on a piece of porcelain, and digested in a few drops of nitric acid. A sulphate of copper is formed, which, when evaporated to dryness, strikes the characteristic deep blue, on the addition of a drop of ammonia.—Copper and sulphur unite by fusion, the combination being attended with the evolution of heat and light. A bi-sulphuret of copper also exists in copper pyrites. Copper combines with a great number of the metals by fusion. It communicates hardness to gold and silver, without much impairing their ductility, or debasing their colour, when in small proportion; hence it is employed in the standard alloys of these metals,

that of gold containing one-twelfth, that of silver one-sixteenth of the mass. With platina, it forms an alloy, ductile, and susceptible of a fine polish. With tin, it forms several valuable alloys, which are characterized by their sonorousness.

The sulphurets are the ores from which copper is usually extracted. The ore is roasted by a low heat, in a furnace with which flues are connected, in which the sulphur that is volatilized is collected. The remaining ore is then smelted in contact with the fuel. The iron present in the ore, not being so easily reduced or fused as the copper, remains in the scoria, while the copper is run out. It often requires repeated fusions, and, even after these, it may be still alloyed with portions of metals which are not volatile, and are of easy fusion. Hence the copper of commerce is never altogether pure, but generally contains a little lead, and a smaller portion of antimony. The carbonates of copper reduced by fusion, in contact with the fuel, afford a purer copper, as does also the solution of sulphate of copper which is met with in some mines, the copper being precipitated in its metallic state, by immersing iron in the solution. The precipitate which is thus formed is afterwards fused.

Copper, being ductile and easily wrought, is applied to many useful purposes. It is formed into thin sheets by being heated in a furnace, and subjected to pressure between iron rollers. These sheets being both ductile and durable, are applied to a variety of uses, such as the sheathing of the bottoms of ships, the covering of roofs and domes, the constructing of boilers and stills of a large size, &c. Copper is also fabricated into a variety of household utensils, the use of which, however, for preparing or preserving articles of food, is by no means free from danger, on account of the oxidizement to which copper is liable. It has been attempted to obviate this danger by tinning the copper, as above described. This method answers the purpose as long as the coating of tin remains entire. Copper may be forged into any shape, but will not bear more than a red heat, and, of course, requires to be heated often. The bottoms of large boilers are frequently forged with a large hammer worked by machinery. The bolts of copper used for ships, and other purposes, are either made by the hammer, or cast into shapes, and rolled. The copper cylinders used in calico printing are either cast solid upon an iron axis, or are cast hollow, and fitted upon the axis. The whole is afterwards turned, to render the surface true.

COPPERAS, or GREEN VITRIOL. A mineral substance, formed by the decomposition of pyrites by the moisture of the atmosphere. Its colour is bright green, and its taste very astringent. A solution of it in water, dropped on oak bark, instantly produces a black spot. Copperas is occasionally found in grottoes, caverns, the galleries of mines, and other places. It is in much

request with dyers, tanners, and the manufacturers of ink, and, for their use, is artificially prepared from pyrites. This mineral being moistened and exposed to the air, a crust is formed upon it, which is afterwards dissolved in water: from this the crystals of vitriol are obtained by evaporation. The principal use of green vitriol is in dyeing woollen articles, hats, &c., black. It is the basis of ink, and is used in the manufacture of Prussian blue. If it be reduced to powder by the action of fire in a crucible, and mixed with powder of galls, it forms a dry, portable ink.

COPPICE, or Corsk. A natural wood of shoots and shrubby trees, periodically cut, and prevented from rising to the proper height of timber-trees. It has the same origin, consists of the same plants, and possesses essentially the same character as a grove,—only that, while the latter matures its trees, the coppice is always retained in the condition of shrubbiness and underwood; it originates in either natural or artificial sowing, and is, in no instance, a plantation; it may be of any extent, from half an acre to many square miles; and if at any time it be thinned and cease to be cut, it rises out of its proper character as a coppice, and assumes the character of a grove.

Many coppices are sown and maintained in parks and pleasure-grounds as objects of ornament and covers for game; and in such situations, when judiciously laid out, and when planned with tasteful reference to the toning of a whole landscape, they appear to great advantage, and form a powerful and agreeable foil to neighbouring groves. Coppices on swelling isles and intricate promontories of fresh-water lakes and marine lakes, have, in many instances, a better effect, because more in symmetry with the other features of the scene, than masses of taller wood; and mimic or miniature coppices are admirably adapted, on principles of both economy and beauty, to occupy small corners and broken spots in arable fields, occasioned by the operations of mining or quarrying, or to cover broken, rugged, and impracticable banks of lakes and rivers. But the principal coppices of Britain are maintained, and in many instances were originated, for the express purpose of furnishing by their produce a profitable return to landlord or tenant; and such of these as are on dry soils, usually consist of oak, hazel, and chestnut,—such as are on medium soils, of maple, ash, and birch,—such as are on wet soils, of willow and alder,—and such as have been ill managed or are on varied soils, of a considerable diversity of trees in both timber and habit. Coppices for profit, in some districts of England, are maintained in strictly coppice condition, or kept entirely free from full-growing trees; and, by being thoroughly swept at every periodical cutting, are supposed to yield a larger remuneration, in the aggregate of years, than if they contained a mixture of tall trees. One con-

sideration for maintaining these is, "that small gains and quicker returns make the dealer rich, while long credit ruins him;" and another, of far higher power, though necessarily of limited local range, is the vicinity of a constant and good market for coppice produce. But coppices for profit in most parts of England and generally in Scotland, are the underwoods of thin groves; or rather what are commonly called coppices, are mixed woods of various sizes and conditions of plants, from the shrub, the sapling, and the shooting stool to the massive and lofty full-grown tree. The most common articles obtained or manufactured from a thorough coppice are ash-hoops, hop-poles, gate-hurdles, and sheep-hurdles; but those obtained or manufactured from a mixed coppice have an exceedingly wide range, and comprise, among other matters, laths, baskets, hedge-stakes, coal-pit props, agricultural implements, and many kinds of carpentry-wood and building timber. A very valuable produce of oak coppices is bark for the use of tanners. See the articles BARKING and OAK. The refuse cuttings of all kinds of coppices, or such as cannot be profitably used for any better purpose, are either burnt for charcoal, made into faggots for fuel, or sold to the manufacturers of pyroligneous acid.

Many persons pay little attention to their coppices except at the times of cutting; but were they to bestow on them proper care and management, they might, in a few years, double their value. Coppices require, more than even arable fields, to be kept well enclosed. When cattle break into a field of wheat, they injure only the crop of one year; but when they break into a coppice, and find opportunity to bite and mangle the young shoots of its plants, they inflict damage equal to the destruction of three years' crops of some kinds, and from four to ten years' crops of others. The bite of cattle, in consequence of the irregularity of its incisions, so lacerates and bruises young ligneous plants, as to do them far more harm than would be done by mere cutting or fracture. Almost any shoot of the first year, which is bitten by cattle, loses a growth of three years; most shoots of from four to six years, are liable, not only to be deprived of the succulent buds upon their top, but to have their whole substance trodden down and disrupted; and oak woods, of all ages, when cropped or browsed upon by cattle, will never afterwards thrive till they are cut over at the ground. Sheep also inflict great damage by rubbing against the trees. Horses, unless much pressed with hunger, are not nearly so mischievous as cattle. Hogs inflict comparatively little injury; and as they feed and fatten well upon acorns, they far more than compensate any small damage they may do, by the acquisition of superior value in their own carcasses. See the articles ACORN, BACON, and HOG. A common form of fence round coppices in some districts is a mound; but this is very liable to be

scraped down and eventually broken through by cattle, and requires to be fortified either with a facing of stone, or with a tangled mass of black-thorn and other brushwood.

Other causes of injury to coppices and of the retardation of their growth are exposure to violent south-west winds and the chilling and sickening influence of wet soil; and these may easily be remedied,—the former by sheltering, and the latter by draining. Sheltering may be effected by a belt of plantation, either of Scotch pine, spruce fir, or any other species of hardy forest-tree best suited to the soil. Drainage, especially for the oak and other species which dislike wetness of situation, has been found as profitable in coppices as in arable land; and, in the wet heavy woodland counties in particular, it makes ample compensation for all the cost and toil which it occasions. But in woods, it must be effected by open cuts; for the roots of the trees would soon disturb and stop up covered drains. If sound enclosure, shelter, and draining were afforded to ill-managed coppices, the plants would instantly begin to enjoy such accelerated growth, that they would double their produce, or afford two ample cuttings in the cycle of years formerly required for one. When coppice land cannot or will not be drained, its growth should be restricted to aquatics,—particularly to willows and alder.

The proper time or interval for the periodical cutting of coppices depends on the species of the wood, the comparative rapidity of its growth, and the uses to which it is to be applied; and it varies in practice from 8 to 30 years. "In favoured situations," said Sir John Sinclair in 1817, "a growth of 12 years is considered to be sufficient; but, in many instances, underwood cannot, by the best management, be made worth more than £8 per acre at 16 years' growth. Twelve small oaks, however, per acre, worth 20 shillings each, may be cut regularly at the same time, which renders the total produce £20 per acre every 16 years. The great wood proprietors in Scotland, generally cut their oak coppices from 20 to 24 years, and it is sometimes extended to 30 years. The principal object in that country is the bark, which is considered to arrive at its greatest perfection, at the age of between 20 and 30 years." A good coppice, in the southern and central counties of England, may be cut in every eighth or ninth year; and, according to the nearness of the market and the goodness of the wood, will then yield a clear receipt of from £6 to £16 per acre.

The thinning and pruning of coppices is a subject of more looseness of idea and diversity of practice than any other part of the treatment; and yet, for all the purposes of economy, requires to be well understood. All young or recently cut oak trees grow with great vigour, and make annually two shoots,—one in the month of June, and the other in the month of August; and the latter of these shoots, called in Scotland the Lam-

mas growth, pushes upward till arrested by frost, and is always the more valuable growth of the two in an oak coppice. Now a newly cut stool sends up, in many instances, from ten to twelve Lammas growths, and, in some instances, has as great a profusion of them as if they rose from a great handful of acorns; and the practical question of chief moment is, How long are these shoots to be permitted to grow before being thinned and pruned? Some foresters say that they should grow for ten or twelve years, in order that their thinnings may be of some value; some say that they should grow for three years, in order that the most vigorous may have time to show themselves, and may be selected for maturing; and some, including the majority in Argyleshire and other parts of the Scottish Highlands, say that they should grow for five or six years, in order that they may have medium advantages between the extremes of three years and twelve years. Mr. Monteath justly condemns the shortest of these periods as far too long, and reasons and advises as follows:—"It is impossible for a tree-root, which is perhaps only 10 inches in circumference, or say even 20 inches in circumference, and few are this size, to cherish or nurse up, with any degree of health or vigour, ten or even twenty young shoots or trees, either to three, six, or ten years, without the tares spoiling the wheat, or the lean cattle eating up the fat, as the one must be evidently spoiling the other; so that the whole crop is much spoiled and lessened in value when it comes to the axe, by want of early thinning. Therefore every natural wood, the second year, should undergo a thinning, that is to say, it gets all the Lammas growth, as it is called, the year it is cut, and then allow it all the next year's growth, when, any time after, from the month of October to the first of April, let the whole wood be gone through, and clear or take away all the growths or young shoots, excepting those you are sure of coming forward to maturity, leaving, at this time, one or perhaps two shoots more on every stool, than what it may be supposed able to nurse up to the full time of cutting. Great care ought to be taken at this time to divide the shoots that are to remain equally, that is to say, to have them at as equal distances from one another, round about the stool, as possible; at the same time, not leaving on any stool, unless a very large one, and that too in an open part of the wood, more than six or eight shoots. This will be found to be as much as any stool can nurse up to the usual age for any purpose. By this early thinning, you have it in your power to leave just such a crop upon the ground, or rather upon your stools, as you are sure nature is able to cherish and nurse up, without overburdening it. At this early period of the thinning, too, you can do it easily, without in the least injuring the shoots that are to remain, as it can be readily done with a short knife; but the newly invented instrument for

thinning natural stools will be found much more handy, and will do it more speedily, safer, and to better purpose, which we may term the coppice thinning-chisel, cutting them off close to where they come out from the stool; and at this time, too, you have an excellent choice of shoots."—*Monteath's Forester's Guide*.—*Nicol's Planter's Kalendar*.—*Sir John Sinclair's Code of Agriculture*.—*Marshall's Rural Economy of the West of England*.—*Marshall's Rural Economy of the South of England*.—*Knowledge Society's Useful and Ornamental Planting*.—*Lisle's Husbandry*.—*Mortimer's Husbandry*.

CORAL BUSH OF ICHABOE. See CERADIA.

CORAL-ROOT,—botanically *Corallorrhiza*. A genus of curious tuberous-rooted plants, of the orchis tribe. The inborn species, *C. innata*, grows wild in the marshy woods of Scotland, but is rare. Its root is fleshy, branching, and brownish yellow; its stem is solitary and about six inches high; and its flowers have a yellowish green colour, are produced in clusters of from five to ten, and appear in June and July. It has no leaves. It exhales, when drying, a powerful and delicious fragrance like that of the aromatic vanilla; and it retains some of this fragrance during many years. Two species, the tooth-rooted and the many-flowered, were introduced in 1820, from North America.

CORAL-TREE. See ERYTHRINA.

CORALWORT. See DENTARIA.

CORCHORUS. A genus of tropical plants, of the lime-tree tribe. Ten species have been introduced to Britain; and about fifteen others have been described. Four of the introduced species are annuals, and six are evergreen, undershrubs; and from two of the former, *C. olitorius* and *C. capsularis*, the Hindoos manufacture a very good cordage. Some or most are supposed to be medicinal; all take their name of corchorus from a word which signifies "to purge;" and most seem to have formerly borne, among British gardeners, the name of Jew's mallow. Miller gives the following account of one of the annual species,—apparently *C. olitorius*,—which he calls Common Jews' mallow:—"This species, Rauwolf says, is sown in great plenty about Aleppo as a potherb, the Jews boiling the leaves to eat with their meat. This he supposes to be the *Olus judaicum* of Avicenna, and the *Corchorum* of Pliny. This plant grows in the East and West Indies; and in the former, it is used in the same manner as in the Levant. It rises about two feet high, dividing into several branches, garnished with leaves of different sizes and form; some are spear-shaped, others oval and almost heart-shaped; they are of a deep green, and slightly indented on their edges, having near their base two bristly segments, which are reflexed; they have very long slender footstalks, especially those which grow on the lower part of the branches. The flowers sit close on the opposite side of the branches to the leaves, coming

out singly; they are composed of five small, yellow petals, and a great number of stamina surrounding the oblong germen, which is situated in the centre of the flower, and afterward turns to a rough, swelling capsule, two inches long, ending in a point, opening in four cells, filled with angular, greenish seeds. This plant flowers in July and August; and the seeds ripen in autumn."—The showy, straggling, many-stemmed, crumpled-leaved, yellow-flowered, hardy, deciduous shrub, called by Linnæus *Corchorus japonicus*, and by De Candolle *Kerria japonica*, seems to be pretty generally known among gardeners and country amateurs only by its specific name *Japonica*. It was introduced from Japan in 1700; and is now very common. It usually has a height of 3 or 4 feet; and, in spite of its straggling and untidy habit, it wins much favour in consequence of making a show of its small rosaceous-looking flowers throughout a great part of the year.

CORDED VEINS. The thickened and inflamed absorbents along the course of the veins during the existence of farcy in the horse.

CORDGRASS. See **SPARTINA**.

CORDIA. A genus of evergreen, tropical shrubs and trees, constituting the type of the natural order Cordiaceæ. This order has a close resemblance to the Convolvulaceæ, and was formerly included in the Boraginæ; but is readily distinguished by its habit, its dichotomous style, and its plaited cotyledons. All its plants are tropical and dendritic; their leaves are alternate, without stipules, and usually very rough; their inflorescence is gyrate, their calyx five-toothed, and their corolla regular; and their fruit is a drupe, with the cotyledons crumpled or folded in plaits. The genera comprised in this order are cordia, patagonula, bourreria, ehretia, and varronia; and the number of species at present in British hothouses is about fifty.

The genus cordia comprises about 60 species; and upwards of one-third of these have been brought to Britain. The introduced species vary in natural height from two yards to about 70 feet; all are beautiful; several constitute extensive and imposing ornaments of their native regions; seven or eight contribute their timber to carpentry and other arts; one, *C. obliqua*, is used in Mysore for the manufacture of cordage from its bark; and three, *C. obliqua*, *C. myxa*, and *C. sebestena*, produce esculent, mucilaginous, succulent fruit, popularly known as Sebesten plums. One of the species seems to have formerly been confounded with *Aquilaria malaccensis*; and a small piece of the wood of several, like the timber of that exquisitely fragrant tree, when heated in the manner of frankincense, perfumes a whole house with a most agreeable odour. See the article **ALOE-TREE**. The drupes of *C. myxa* and *C. sebestena*, were formerly used in medicine, and might often be seen in the shops of London under the name of Assyrian plums.

CORDIAL. A mixture of aromatic and stim-

ulating drugs. It is a kind of medicine of nearly the same nature to a horse as ardent spirits are to a human being; and, in consequence of being administered too frequently or in excited states of the system, it is the means of debilitating or killing many a fine animal. A horse thoroughly exhausted by labour and disinclined to take any food,—or a draught-horse over-worked, half-starved, and somewhat inclined to stagger,—or a hard-worked, old horse who was accustomed to receive occasional stimulants when young, may derive considerable benefit from a cordial; but a horse in almost any other condition, especially one who is in any degree fevered, might nearly as well receive a smart dose of some active poison. Cattle are not so readily liable to injury from cordials as horses, and may, in a greater number of instances, experience benefit from their effect; yet even they ought not to receive them in three-fourths or more of the cases in which most cow-doctors administer them. A proper cordial ball for a horse may consist of two ounces of any of the following mixtures,—first, 4 oz. of cummin seeds, 4 oz. of anise seeds, 4 oz. of caraway seeds, 2 oz. of ginger, and enough of treacle to work these ingredients into a mass; second, 4 oz. of anise seeds, 4 oz. of caraway seeds, 4 oz. of sweet fennil seeds, 4 oz. of liquorice powder, 1½ oz. of powdered ginger, 1½ oz. of powdered cassia, and a sufficient quantity of honey; third, 4 oz. of cummin seeds, 4 oz. of coriander seeds, 4 oz. of caraway seeds, 1 oz. of grains of paradise, ½ oz. of powdered cassia, 2 drachms of cardamom seeds, 2 drachms of saffron, 4 oz. of liquorice dissolved in white wine, and a sufficient quantity of syrup of saffron. But the last of these is very powerfully stimulating; and ought never to be administered except in an extreme case. A proper cordial ball for a cow may consist of 1 oz. of powdered caraway seeds, ½ oz. of powdered gentian, ½ oz. of powdered ginger, and 20 drops of essence of peppermint; and a proper cordial drink for a cow, to be administered morning and evening, may consist of one-half the quantity of these ingredients, in a pint of warm ale and a pint of thin gruel.

CORDS, or GUT-TIE. A disease in the intestines of oxen. It consists in the strangulating tie of some part of the intestines,—usually of the small intestine,—either by the spermatic cord, which had retracted into the abdomen in consequence of unskilful castration, or of an adventitious membrane unnaturally and diseased formed in consequence of the use of mouldy, unwholesome fodder, or of frequent stressing of the lower part of the abdomen. Some of its symptoms are disinclination to food, striking the abdomen with the hind feet, occasionally stretching out the body in so extraordinary a manner as to give the back a concave curvature, voiding fæces in small quantities, mixed with mucus and blood, and evincing excessive pain when the hand of the surgeon is introduced into the rectum. A dangerous and

difficult surgical operation seems to be the only remedy.

CORDWOOD. The topwood, twigs, roots, and other small and refuse wood of coppices, disposed in heaps and sold for fuel and for the uses of ships of war. It acquired its name from the circumstance of its having formerly been measured with a cord. A statute heap of cordwood is 8 feet long, four feet broad, and 4 feet high.

COREOPSIS. A genus of ornamental herbaceous plants, of the sunflower division of the composite order. About 25 species have been introduced to Britain, principally from North America and the West Indies; these vary in height from 2 to 10 feet; all, with two partial exceptions, have yellow-coloured flowers; and four are hardy annuals, one is a tender annual, two are hardy biennials, one is a tender biennial, two are tender climbing perennials, and all the others are more or less hardy deciduous perennials. Two or three of the hardy annuals possess a comparatively high degree of beauty; and the flowers of the ear-leaved perennial, *Coreopsis auriculata*, as well as those of an annual species, formerly called *Coreopsis tinctoria*, but now called *Calliopsis bicolor*, are used by the people of North America for the extraction of a reddish dye. Some of the American species are popularly called Virginian corn marigold; and a considerable number of species which were formerly comprised in the genus *coreopsis*, are now distributed among nine other genera.

CORETHROSTYLIS. A recently discovered genus of Australian ornamental shrubs. The rosy-armed corethrostylis, *C. bracteata*, was introduced to Britain from the Swan-river settlement in 1844. Its leaves are heart-shaped, hairy, and fragrant, and stand on long footstalks. Its flowers are stellate, have a pinkish-rose colour, are produced in forked spikes, and flourish in great profusion; and beneath each floral spike is a little rosy bract or rose-coloured leaf. This shrub seems to possess the degree of tenderness which is common among New Holland plants.

CORIANDER,—botanically *Coriandrum*. A small genus of annual plants, of the umbelliferous order. The cultivated species, *Coriandrum sativum*, was originally introduced to Britain from Italy, but now grows wild in fields about Ipswich, and in some parts of Essex. Its stem is erect, smooth, round, branching, and about two feet high; its leaves are compound,—the lower ones pinnated, with cut cuneiform folioles, and the upper ones thrice ternate, with linear pointed segments; both its chief and its subordinate umbels are much rayed; its flowers have a reddish-white colour, and appear in June; and its fruit is globular and obscurely ribbed, and comprises two concave hemispherical seeds. The whole of the plant, in a green state, has a very offensive odour; and the seeds, when ripe and dry, have an agreeable aromatic smell, and a somewhat warm and pleasantly aromatic taste.

The leaves, when raised in garden culture, are used in soups and salads; and the seeds, as obtained by either garden or field culture, yield an essential oil, have carminative and aromatic properties, and are extensively used for their agreeable flavour in confectionary, and for their medicinal properties or for modifying the taste of nauseous drugs in pharmacy.

The cultivated coriander is frequently grown, in the south of England, conjointly or mixedly with caraway; and it might, no doubt, be successfully and profitably cultivated in the same manner in other parts of England and in the south of Scotland. See the article *CARAWAY*. But a mode of joint growth with caraway, seemingly preferable to that which is practised by the English farmers, would be to sow the two crops in alternate drills, and so permit the caraway to be easily hoed and cleaned after the removal of the coriander.—Sowings in the garden may be made under a frame in early spring, in the open ground at intervals from middle spring till the end of August, and again under a frame in September and October. The sowings may be made half an inch deep, and in drills 8 inches apart; and the young plants ought to be thinned out to distances of four inches from one another, and kept clear of weeds, but will not endure to be transplanted.—Two uninteresting annuals formerly regarded as corianders now constitute the genus *biforis*; and two other species still regarded as corianders are known to botanists.

CORIARIA. A genus of plants, constituting the natural order Coriariæ, or Coriariaceæ. They are somewhat allied to the rutaceæ, but have no dots on their leaves. Only seven species are known; and two of these, the myrtle-leaved and the twiggy, occur in British gardens. The myrtle-leaved, *C. myrtifolia*, is a hardy, evergreen, ornamental shrub; and was introduced from the south of Europe in the former half of the 17th century. Its stem and branches are covered with greyish spotted bark, and usually attain a height of from 4 to 6 feet; its wood is very brittle, and full of light pith; its young shoots are angular, and grow in great number, and in groups of three or four; its leaves are opposite, oblong, pointed, bright green, and coriaceous; its flowers grow in spikes at the ends and sides of the branches, have a greenish colour and but little beauty, and bloom from May till August; and its berries are succulent and very poisonous. The leaves have astringent properties, and are employed by dyers for dyeing black. The leathery texture of the leaves gives occasion to the generic name *coriaria*, which is formed from a word signifying 'leather;' and a certain resemblance which they bear to the leaves of myrtle, gives occasion to the specific name *myrtifolia*,—and also attaches to the plant the popular name of myrtle-leaved sumach.

CORISPERMUM. See *TICKSEED*.

CORK-TREE,—botanically *Quercus Suler*. A

hardy, evergreen, economical, and ornamental tree, of the *ilex* division of the oak genus. It abounds, in both a wild and a cultivated state, in Spain, Portugal, and the south of France; and was introduced to Britain, by the Duchess of Beaufort, in 1699. But it can thrive or even live in England only in warm sheltered situations; and it seldom, even in these, attains the height or fully develops the cork-producing character which belong to it in its native regions. Three very distinct varieties of it are known and cultivated, the narrow-leaved, the broad-leaved, and the toothed-leaved or dentated, each characterized by the feature of leaf mentioned in its name, and the first usually rising to a height of 30 feet, the second to a height of 40 feet, and the third to a height of 50 feet. The toothed-leaved, indeed, has sometimes been called pseudo-suber, or false cork-tree, or bastard cork-tree; but the real *Quercus pseudo-suber* is a distinct species, a mere timber-tree, flowering earlier than the true cork-trees, and perfectly distinct in both character and habit from the *Quercus suber dentatum*.

The three varieties of true cork-tree are so closely akin to one another in habit and value, that a notice of one will sufficiently describe the whole. We select the broad-leaved,—*Quercus suber latifolium*. Its trunk seldom attains a girth of more than three feet; its timber, though compact and heavy, is not so durable as that of the common oak; its young bark is white and downy, and afterwards becomes smooth and grey, but exhibits no resemblance to the old, dead, thick, rough, and spongy bark which constitutes the cork of commerce; its leaves are oblong, oval, serrated, smooth and deep green above, downy below,—and they grow on strong but very short footstalks alternately on the branches, and differ very little in appearance from those of many sorts of *ilex*; its flowers are apetalous and inconspicuous, and appear in June; and its acorns are smooth, longish, brown, and almost undistinguishable, in size, shape, and general appearance, from those of the common oak. A cultivated cork-tree is barked when about twenty or twenty-five years old, and afterwards at the close of every interval of ten years. But the produce of the first barking is useless for corks, and is removed simply with the design that a better may succeed; and though the produce of the second barking is better than that of the first, only the produce of the third and of subsequent barkings is fit for making thoroughly good corks. The proper season of barking is July and August; and the proper manner of the operation is to peel off, in one stratum, and with an instrument for the purpose, all the layers of dead bark, using care not to damage the living cortex, and especially not to make any incision into the alburnum. The spongy, fungous, dead cortical matter which constitutes the cork, is, as regards the living organism and vital processes of the tree, really an excrement; and the removal of it, while providing an article of

great utility to man, actually promotes the health and vigour of the plant. See the article BARK. “Wonderful, then,” as old Hanbury piously remarks, “is the wisdom and goodness of Almighty God, and calls for our profoundest admiration, that he should not only provide us his creatures such varieties of things for use, but cause, as in this instance, what would be death to one tree, to be refreshment to another, for the supply of our necessities, and in the formation of this tree, not only causing the cork to grow, but providing also an interior bark sufficient to nourish the tree, and even in a manner exhilarate it, as the loaded wool is shorn from the fleecy kind. To make our gardening to the utmost degree useful, we should be always exercised in these considerations, and this will inspire us with acts of gratitude and obedience.”

CORN. The cereal grasses, particularly wheat, barley, oats, maize, rice, and rye. By an absurd provincial usage, the name corn is restricted by most persons of the lower and middle classes in Scotland to oats; and by a general popular license, it is occasionally extended, in all parts of the empire, to all sorts of seed-crops grown on British farms, even to all kinds of seeds, domestic and foreign, which can in any way be used for food. But desirable precision in agricultural language requires that the name be strictly appropriated to the cereal grass. The articles in which most matters of interest connected with corn are discussed, are those on WHEAT, BARLEY, OATS, RYE, MAIZE, RICE, SOWING, REAPING, BARN, GRANARY, BREAD-CORN, ACCIDENTS, FROSTED-CORN, THRASHING, STRAW, and CHAFF.

CORN. A disease in the feet of horses. It so far resembles corn in the foot of man as to occasion lameness, and to be caused by prolonged pressure. It constitutes unsoundness in a horse; and though assignable to prolonged pressure as its immediate cause, is always the remote consequence of unskilful shoeing or of bad management of the feet. It occurs in the angle between the bars and the quarters, and gives the horn of that part a red appearance and a somewhat soft and spongy texture. It receives great pain from pressure; and, when neglected, it occasions successively inflammation, suppuration, and quittor. As soon as it is observed, it ought to be cut away with a small drawing knife, and the shoe so applied as not to make any pressure upon the tender part; and when it is so long neglected as to entail suppuration, an opening for the escape of the pus should be made between the bar and the crust, the sore should be dressed with compound tincture of benzoin, the cavity should be loosely filled with digestive ointment, and the foot should be protected by means of a bar-shoe.

CORN-BARN. See BARN.

CORN-BIN, or CORN-CHEST. An oblong box, of any convenient capacity, to hold oats or other grain for the use of horses. In any ordinary farm-stable, it may stand in the broad passage

behind the horses, or any other convenient place; but it should have a communication from the granary by a spout or wide square pipe; it requires to be strong, and to have good hinges; and, when of a high and narrow form, it should be so constructed as to let part of its front fold down when the supply of corn within falls low. Occasional or periodical supplies of corn for the corn-bin should be measured in the granary, and shovelled through the communicating spout; and the quantities or meals for the horses should be regularly measured with a vessel kept constantly in the bin.

CORN-BAND. See **BANDS**.

CORN-BARROW. See **BARROW**.

CORN-BASKET. A basket of close and beautiful wicker-work, used instead of wechts in the barns of some districts of England. See the article **BARN-MANAGEMENT**.

CORN-BOX. A contrivance for affording sheep an occasional feeding with grain, in aid or modification of general feeding with turnips. The common corn-box is a very simple wooden structure; it has a hollow bottom to contain the corn, and a roofed cover to protect it from the weather; and it is open on one side, and only on one side, to permit free access to the sheep. But a more elaborate corn-box is in use, mounted on low wheels to allow it to be easily moved from place to place, and so constructed as to keep the corn constantly covered except when sheep are in the act of feeding upon it. The box itself is mounted on a frame, and has the same general character as a hay-rack; the lower part of the frame is provided with two hinged platforms, which communicate with the lids of the box by means of upright rods so attached as to act like levers; the lids of the box are opened by these connecting rods when the platforms are trodden upon, and closed when the platforms cease to be under pressure; and hence a sheep, by placing its feet upon a platform, opens a lid and has access to the corn, and yet, on going away, does not leave any part of the remaining corn in a state of exposure to the weather. A simple and obvious interior contrivance lets the lever-acting platforms command the corn; and a small hinged lid in the higher part of one of the hinged sides, allows fresh supplies of corn to be poured into the box.

CORN-BRUISER. See **BRUISING GRAIN**.

CORN-BUSHEL. See **BUSHEL**.

CORN-CHEST. See **CORN-BIN**.

CORN-COCKLE,—botanically *Lychnis Githago*, but formerly *Agrostemma Githago*. An annual, purple-flowered weed, of the carnation order. It infests the corn-fields of Britain, particularly fields of wheat, and makes a prominent figure among the weeds of agriculture. Its stem is woody and about 3 or 4 feet high; its flowers are somewhat showy and appear in June and July; and its seeds are rough, globular, black in the exterior, and white in the interior. This plant is sometimes the chief weed in wheat fields;

and its seeds find their way into many samples of good grain, and considerably deteriorate their value with corn-dealers and bakers; yet they have such a colour in a ground condition as to be undistinguishable from wheat flower, and are quite innocuous. Corn-cockle ought to be hand-weeded when in flower, or when the grain crop which it infests is about 20 or 24 inches high.—A foreign, white-flowered variety, called Nicean, was introduced to Britain from Italy toward the close of last century, and ranks among the coarse, hardy, ornamental annuals.

CORN-CRAKE.—scientifically *Crex pratensis*. An extensively diffused European bird, of the rail family. Frequent synonymous names for it in England are land-rail, corn-drake, and dakerhen; and a not uncommon, though stupid mistake confounds it with the water-rail,—*Rallus aquaticus*. Its length is 9 or 9½ inches; its bill is strong, thick, greyish brown, one inch long, and shaped exactly like that of the water-hen; its eyes are hazel-coloured; the feathers of its upper parts are rufous brown, with a dash of black down the middle of each; the feathers of its under parts are similar to the others, but paler, and not spotted; the quills and the coverts of the wings are lightish chestnut; the fore-part of the neck and breast, and a streak over each eye, are of a pale ash-colour; the belly is yellowish white; the sides and thighs are faintly marked with rusty-coloured streaks; the tail is short and of a deep bay; and the legs are greenish brown. This bird occurs over all continental Europe, and in most districts of the three kingdoms; but it is exceedingly abundant in some places, and very scarce or almost wholly unknown in others. It abounds in Holland, in most of Ireland, in the Isle of Anglesea, and in the county of Caithness; and it occurs more or less in every part of England and in most parts of Scotland, but is abundant in few and decidedly scarce in several. It begins to be heard in Britain about the middle of May; it continues its peculiar cry—which is the call of the male to the female—during all the breeding season; and it migrates, before winter, to other lands in search of worms, slugs, insects, and certain seeds which combinedly constitute its proper food. It frequents meadows, corn-fields, and all grounds of other kinds which are covered with high and dense herbage; and it sends out from the thickest parts of them, an arresting, monotonous cry, so peculiarly its own as to be ever remembered by any person who has once heard it. The sound of the cry is a sharp creek-crek-crek, and resembles the noise made by forcibly stripping the teeth of a large comb with a stick. But the bird, though often heard, cannot be easily seen; for it dexterously baffles search, swiftly escapes pursuit, slyly refuses to take wing, and so cunningly and careeringly glides among the grass as to tantalize alike the school-boy and the sportsman. It breeds on the ground, and makes its nest of dry moss or

dry grass in little grassy hollows. Its eggs are about the size of those of the partridge, and have a yellowish-white colour, marked with dull rust-coloured spots; and its young are covered with a black down, and run as soon as they leave the shell, and become able in six weeks to fly, but seldom quit the meadow till the scythe destroys or lays bare their habitation. The flesh of the corn-crake is esteemed a great delicacy; and the bird is, in consequence, an object of much interest to both the sportsman and the mower. In the island of Cyprus, corn-crakes and partridges have twenty-four times the market value of beccaficos and ortolans, and are exceeded in value only by snipes; and all other birds, both aquatic and terrestrial, are there so cheap that they are rather given away than sold.

CORN-CROWFOOT. See CROWFOOT.

CORN-CUTTING MACHINES. See REAPING MACHINES.

CORNEA. See EYE.

CORNEL and CORNELIAN CHERRY. See DOGWOOD.

CORNFLAG,—botanically *Gladiolus communis*. A weedy, hardy, and vivacious plant of the tuberous-rooted and magnificently flowering genus *gladiolus*. The name cornflag, indeed, is, in a desecrating sort of way, applied by some writers to the whole of that superb genus; but it cannot, with any propriety, be extended farther than to the common species. This plant grows naturally in the arable fields of the south of Europe; and though not introduced to Britain till about the end of the 16th century, it became, so far back as nearly an hundred years ago, a wide-spread and exceedingly troublesome weed of many British gardens. Its root is tuberous, compressed, and yellowish, has a brown furrowed skin like that of the yellow vernal crocus, and is so vivacious and fecund that, when once established in a piece of ground, it cannot without much difficulty be eradicated; two flat, stiff, sword-shaped leaves, rise from the root, embrace each other at the base, have an enveloping sheath of one or two narrow leaves round their lower part, and grow to the height of about two feet; the flower-stem rises between these leaves, and bears the flowers on one side of its upper part; the flowers are five or six in number, project in a series from the side of the stem, have a purplish red colour, appear in June and July, and, though monopetalous, are so deeply cut into six segments as to appear like flowers of six variously spreading petals. Two varieties of this plant long ago sprang up and spread in Britain,—the one with white flowers, and the other with flesh-coloured flowers. Whenever cornflag gets fairly hold of a garden or a field, it contends as sturdily as colt's-foot against all ordinary efforts for its extirpation. See the article COLT'S-FOOT.

CORN-MARIGOLD. See CHRYSANTHEMUM.

CORN-MARKET. A market-town in which farmers sell their corn to bakers, millers, brewers,

distillers, and corn-merchants. A sample market for corn is one in which farmers show only hand samples of their commodity, and engage to purchasers to deliver the stock at appointed place and time; and a stock-market for corn is one in which farmers exhibit on their carts all the stock which they are prepared to sell, and which they deliver to purchasers as soon as it is sold. Certain disadvantages and inconveniences encumber each of the two kinds of market; but those which encumber the sample market are the easiest for both farmer and purchaser. Corn-market is sometimes understood aggregately, or as comprehending the whole of the corn-trade.

CORN-MEASURES. See BUSHEL.

CORN-MINT. See MINT.

CORN-MOTH, or CORN-WORM,—scientifically *Tinea granella*. A mischievous, corn-eating, lepidopterous insect, of the teneidæ family of moths. It sometimes attacks corn while in the sheaf, but principally infests granaries; it feeds on all sorts of grain, but is most partial to wheat; it has long made great devastations among corn in France; and though not as yet so far diffused or so mischievous in Britain as to excite any immediate apprehension, it possesses instincts and habits which ought to be known to all farmers, and which may become matter of serious practical study to some. The imago or perfect moth does not exceed half an inch in length; its wings, when laid over each other, slope at the sides; its upper wings have nearly an uniform breadth, and are whitish-coloured, with dark brown and dusky spots; its body is brown, variegated with white; and its head has a thick tuft of yellowish-white hairs. Thirty eggs or upwards are laid by each female,—all so minute as to be scarcely observable by the naked eye; and one or two are attached to a single grain of corn. The young larva or caterpillar is speedily hatched; it immediately bores its way into the grain, closes up the opening by which it entered, and remains in the interior till it eats up everything but the husk; it then passes into another grain, to repeat the same process,—and into another and another till it becomes full-grown; it glues together all the grains which it has used, and tracks all the path over which it passes, with a silken and somewhat excrementitious web; and when full-grown, it leaves the chain of emptied grains on which it fed, and runs athwart all the neighbouring corn, covering it more or less with greyish-white webs. The full-grown caterpillar is about half an inch long, and has 16 feet; and its body is yellowish-white, its head brownish-red, and its neck marked with two transverse brown stripes. When running athwart the corn, it is in search of a retreat for transmutation into a chrysalis; and, in almost any barn or granary, it will readily enough find such a retreat in some little crack or crevice of the floor, the walls, or the roof. The state of chrysalis or of envelopment with cocoon is of long duration, usually continuing through the whole

winter and the early part of spring.—When the existence of chrysalides of the corn-moth in a granary is known or suspected, the floors, walls, and roof ought, in the latter part of autumn or in winter, to be well swept with a hard brush, or washed with some caustic solution; and when the caterpillars have effected a lodgment, and the corn is not to be used for sowing, the whole of the grain should be kiln-dried.—Another species of corn-moth, *Tinea hordei*, is known on the continent; but it confines itself principally to barley, and does not seem to occur in Britain.

CORN-POPPY. See POPPY.

CORN-RAKE. See RAKE.

CORN-SACK. See SACK.

CORN-SALAD,—botanically *Valerianella olitoria*. An indigenous, cultivated, annual plant, of the lamb's lettuce genus. It grows wild in the corn fields of Britain, especially in light soil; and it has long been cultivated for winter and spring salads. Its radical leaves are from three-fourths of an inch to two inches long, according to the goodness of the soil,—and they are oblong, broad and rounded at the extremity, and narrow and embracing each other at the base; its stem leaves occur in pairs at the points, and are similarly shaped to the radical leaves, but smaller; its stem is angular, and from 3 to 9 inches high, and divides into two branches, each of which divides into other two; its flowers are produced in clusters at the end of the branches, and, in their wild state, usually appear in April and May; and its seeds are roundish, compressed on one side, and comparatively large, and are very apt to drop before they attain their ripened colour. This plant is cultivated as a spring salad herb, but in consequence of having a strong taste which many palates dislike, it is less used than at a former period. It should be sown about the latter end of August, on the spot on which it is intended to remain, and it will be fit for use early in spring. Persons who relish it may have it during the greater part of the year, from monthly or fortnightly sowings, commencing in February and ending in September. It is not fastidious as to either soil or treatment.

CORN-STUBBLE. See STUBBLE.

CORNUCOPIA. A hardy annual grass, of the phleum or phalaris tribe. It constitutes a genus of itself, and takes for its specific name *cuculatum*. In spite of its bearing the pretending and pompous name of the horn of plenty, it is far more curious than useful. It was brought to Britain from the Levant in 1788; and it grows about 6 or 8 inches high, and flowers in August.—Cornucopia or cornucopiæ is also a hardy and somewhat ornamental annual, of the small genus *Fedia*, belonging to the order Valerianæ. It grows a foot high, carries red flowers in June and July, was brought from the south of Europe toward the close of last century, and is the only kind of *fedia* known in Britain,—though some of the old botanists classed the corn-salad as a *fedia*.

CORNUS. See Dogwood.

CORNUTIA. A beautiful, evergreen, hothouse shrub, of the verberna tribe. It constitutes a genus of itself, and is specifically designated pyramidata; but it is closely allied to the genus *hosta*. It is a native of Mexico and the West Indies, and was introduced to Britain during the former half of last century. It has a height of from 6 to 12 feet; its branches are straggling; its leaves are opposite; and its flowers have a fine blue colour, and are produced in spikes at the end of the branches, and usually appear in July and maintain their beauty through two months of autumn. It may be propagated from either seeds or cuttings.

CORNWEED, or HATCHET-VETCH,—botanically *Biserrula Pelecinus*. A hardy, annual, handsome plant, of the pea tribe. It was brought to Britain from the South of Europe, about the middle of the 17th century, and is the only known species of *biserrula*,—a name which signifies “a double little saw,” and alludes to the sawed outline of both sides of the pods. The stems of the plant are numerous, angular, and trailing; its leaves are long and pinnated, each consisting of many pairs of cordate leaflets, and a terminating odd one; its flowers are small, purplish, and papilionaceous, grow in small groups on footstalks toward the upper part of the branches, and appear in July and August; and its pods are about an inch long, and contain two rows of kidney-shaped seeds.

CORN-WEEVIL. See CALANDRA.

CORN-WORM. See CORN-MOTH.

COROLLA. The inner one of the two leafy whorls which envelope the reproductive organs of a phænogamous plant. It has generally a finer texture than the calyx or outer envelope; it, with very few exceptions, possesses all or most of the brilliant colours and agreeable odours which distinguish flowers; it is frequently the only part which the popular mind pronounces really floral; and it well deserves its proud name of corolla, or crown and chaplet of the whole plant. Yet in all the numerous phænogamous plants which are designated apetalous, such as all the grasses and very many of the monœcious and diœcious classes, the corolla is totally wanting; in numerous others, it constitutes the only envelope of the reproductive organs, no calyx being present; in a few, a single coloured envelope exists, of so doubtful a character as to be taken by some botanists for a corolla, and by others for a calyx; and in some, either the calyx is so highly coloured as to be readily mistaken by an unscientific observer for a corolla, or the calyx and the corolla are so blended into each other in both form and colouring as to be popularly mistaken for a single floral envelope. Yet notwithstanding these varied and very numerous exceptions, a corolla is, *par excellence*, a flower, and possesses the attraction of at once colour, shape, and fragrance, for the sake of

which most wild plants are admired and the great majority of ornamental plants are cultivated.

The corolla consists either of one piece or petal, and is monopetalous, or of several pieces or petals, and is polypetalous. A monopetalous corolla may be bell-shaped, funnel-shaped, club-shaped, hood-shaped, or wheel-shaped, or may possess any one of many varieties of intermediate form; yet, in every instance, it is regarded as consisting of three parts,—tube, mouth, and border. The tube is the lowest part, and is usually cylindrical and open; the mouth or throat is the middle part, and is often so pubescent or scaly as to be almost choked up; and the border is the outmost, and usually possesses the most marked characters of both shape and tinting. A polypetalous corolla may be cruciform, butterfly-shaped, rosaceous, five-winged, or six-winged, or may exhibit any one of numerous diversities in either the disposition, the relative proportions, or the individual forms of its petals; yet each of its petals, whatever be their number, their aggregate contour, or their individual character, is regarded as consisting of two parts,—a lower one or claw, and an upper one or border.

Any corolla which is accompanied by a calyx, and which is itself delicate in texture, brilliant in colour, and comparatively large in size, differs from every other leafy part of the plant in refusing to decompose carbonic acid, and in dealing with atmospheric air exactly as it is dealt with by the lungs of animals; and it may be regarded as exerting some special influence upon the enclosed reproductive organs, and as itself enjoying protection and support from the calyx. Yet, in the very numerous instances in which the corolla is inconspicuous, or in which only one whorl envelopes the reproductive organs, no difference of function between corolla and calyx can be observed to exist. The occasional difficulty of deciding whether a one-whorled envelope be a corolla or a calyx is sometimes expounded by a series of not very intelligible rules, sometimes evaded by applying to the envelope the ambiguous name of perianth, and sometimes summarily disposed of by pronouncing every one-whorled envelope to be a calyx. See the article CALYX.

CORONET. The small pastern bone, or lowest part of the pastern, of a horse's foot. It articulates with the coffin and the navicular bones; and is united to both by the capsular and the lateral ligaments. The coronary ligament is a prolongation of the skin, or a vascular expansion, projecting and extending around the coronet to the back of the frog, possessing in its texture a great profusion of small blood-vessels, and forming from these vessels the secretion which constitutes the hoof, or crust, or wall of the foot. The coronary ring is a membrane which covers the coronary ligament, and extends round the upper portion of the hoof.

CORONILLA. A genus of ornamental plants, of the hedyсарum division of the leguminous or-

der. The scorpion-senna species, or jointed-podded colutea, *Coronilla Emerus*, is a native of the south of France, and was introduced to Britain near the end of the 16th century. It is a hardy deciduous shrub; but though an old and not infrequent member of shrubberies, it is by no means so generally cultivated as it deserves. Its usual height is from 3 to 6 inches; its branches are numerous and irregular, and abound near the ground as well as toward the top; the bark of the older branches is greyish, and that of the younger is smooth and dark brown; the leaves are pinnated, each consisting of three pairs of folioles and a terminating odd one, and they have a pleasant green colour, and possess great aggregate beauty; and the flowers have a yellowish colour, are large in proportion to the shrub, appear from April till June, and come out on long footstalks, and in groups of two or three on each footstalk, all along the sides of the branches beside the leaves. "Beautiful as the leaves are," remarks Marshall, "it is the flowers which constitute the beauty of this shrub; and indeed of all the shrubby tribe, there is none more striking or pleasing than this when in full blow. This usually happens in May, when it will be covered all over with bloom, the shrub itself appearing as one large flower divided into many loose spikes." And, says Loudon in his Arboretum, "The mingling of yellow flowers with flower-buds more or less red, and the elegant foliage, renders this hardy shrub a very desirable one for its beauty." Another recommendation of it is that it frequently flowers again in autumn. A variety of it, of lower growth than the normal plant, is known as the dwarf scorpion-senna.—Fifteen other species, all more or less hardy, all decidedly ornamental, and chiefly natives of countries adjacent to the Mediterranean, are cultivated in British gardens; and some more species are known to botanists, but have not yet been introduced. One of the introduced species, the Cretan, is a striped-flowered annual; three, with respectively pink, white, and yellow flowers, are herbaceous trailers; one with yellow flowers, and two with white flowers, are perennial-rooted herbs; two are yellow-flowered evergreen herbs; and the remaining six are yellow-flowered evergreen shrubs.

CORONOPUS. See PLANTAIN and WART-CRESS.

CORRÆA. A genus of beautiful, evergreen, Australian shrubs, of the rue tribe. They follow the type of the Cape diosmas, and have become conspicuous ornaments of almost every good British greenhouse. The first known species, *C. alba*, was introduced from Australia in 1793; and four other species, *C. virens*, *C. speciosa*, *C. rufa* and *C. pulchella*, were introduced before 1825. Two of these species carry white flowers, one scarlet flowers, one green flowers, and one scarlet and green flowers; and they vary in height from 3 to 8 feet. A more recently introduced species, *C. bicolor*, is one of the best habited and most beautiful of the

whole tribe. Its stem is strong and stocky; its leaves are thick, rough, and very bright; its tubular flowers are half bright scarlet and half light green, in a similar manner to those of *C. speciosa*, but are shorter and not so thin; and its whole appearance, even when out of flower, is not a little handsome. But a race of exquisite hybrids have been raised in England, principally by Mr. Milner; and these have greatly eclipsed all the natural species except *C. bicolor* and *C. speciosa*, and constitute a large proportion of the choicest corraes at present in cultivation. One of the most imposing of the hybrids is *C. longiflora*; its leaves are ovate, obtuse, and covered on the upper surface with a slight ferruginous down; and its flowers are very long, and are covered with a similar down to that which is on the leaves, and have a delicate rose colour, altogether untinted with any other hue. Others of the fine hybrids and varieties are known as *C. Milnerii*, *C. Harrissii*, *C. grandiflora*, *C. Cunninghamii*, *C. rosea*, *C. rosea major*, *C. quadriformis*, and *C. speciosa major*.

CORROSIVE SUBLIMATE,—chemically *Bichloride of mercury*. A most powerful medicinal preparation, acting in even very small quantity as a virulent poison. It is prepared by subliming a mixture of two equivalents of chloride of sodium and one equivalent of bisulphate of peroxide of mercury; these substances producing, by mutual change of elements, an equivalent of corrosive sublimate and two equivalents of sulphate of soda. Corrosive sublimate is a colourless, semi-transparent, crystalline substance; it has an acrid, burning taste, and leaves upon the tongue a nauseous metallic flavour; it is upwards of five times the weight of its own bulk of water; it can be dissolved in twice its weight of boiling water, but cannot be dissolved in less than twenty times its weight of cold water; and, when taken into solution in hot water, it subsides, in the process of cooling, into prismatic crystals. It is sometimes most advantageously administered, in small doses, for farcy in horses; it is often used, in solution, as an external application, to cure scab and mange, to destroy vermin, and to dispose deep and refractory ulcers to heal; and it is occasionally employed, in very weak solution, to remove cloudiness from the eyes of animals. But in all cases, especially of internal exhibition, it is vastly too active a substance to occupy a place among the home-drugs of a farm, and still less among the medicaments of a quack; and it ought to be known by any but professional persons, only that it may be shunned and dreaded in precisely the same degree as arsenic.

CORSELET. See THORAX.

CORTEX. See BARK.

CORYANTHES. A very curious, singularly splendid, and recently introduced genus of tropical epiphytous plants, of the orchis tribe. The spotted species, *C. maculata*, was brought to Britain from Demerara in 1829. Its stem is usually

about a foot high; and the parts of its flowers are so curious in form and colouring, and so very varied in appearance, that an observer who, for the first time, observes them pendant on the trunks of trees in their native region, doubts whether they are flowers, insects, or birds. "The lip is furnished near its base with a yellow cup, over which hang two horns constantly distilling water into it, and in such abundance as to fill it several times; this cup communicates by a narrow channel formed of the inflated margin of the lip, with the upper end of the latter; and this also is a capacious vessel very much like an old helmet, into which the honey that the cup cannot contain may run over." The helmet-like vessel has suggested the name *Coryanthes*, which signifies 'helmet-flower.'—A species, fully as curious as the preceding, though not so florally splendid, *C. macrantha*, has been introduced from the Caraccas.

CORYCARPUS. A genus of grasses, of the fescue tribe. Only one species, the reed-like, *C. arundinaceus*, is known; and this was brought from North America about 36 years ago, and was called by Michaux *Festuca diandra*. Its root is perennial; its culm rises to the height of between two and three feet; its flowers appear from April till July; and its seeds have a curious, helmet-like appearance, and are alluded to in the name *corycarpus*.

CORYDALIS. A genus of hardy ornamental plants, of the fumitory tribe. The hollow-rooted species, *Corydalis tuberosa*, formerly called *Fumaria cava*, was introduced to Britain from the south of Europe near the close of the 16th century; and it was, for a long time, a favourite as an ornamental plant, but was eventually superseded by more showy novelties. Its root is tuberous, large, and hollow in the middle; its stem is about six inches high, and does not ramify; a single ramose leaf, somewhat like that of the common fumitory, but with broader lobes, garnishes the bottom of the stem; and its flowers are produced in a spike at the top of the stem, have a pale purplish colour, and appear from February till May. A variety of this species, *C. t. albiflora*, has white-coloured flowers, and is considerably taller than the normal plant. A peculiar alkaline principle, to which the name of *corydalin* has been given, exists in the root of *Corydalis tuberosa*, as a soluble malate, and can be precipitated from its aqueous solution by magnesia, and purified by alcohol.

The yellow corydalis, *C. lutea*, is a perennial-rooted indigenous herb, with a stem about 20 inches high, and with yellow flowers blooming from April till October, occasionally to be seen on old walls in England.—The tendrilled species, *C. claviculata*, is a climbing annual plant of British thickets, growing to the height of 6 or 8 feet, and carrying whitish-yellow flowers in June and July.—The bulbous species, *C. bulbosa*, formerly called *Fumaria solida*, is a beautiful tuberous

rooted, pink-flowered inhabitant of British groves, growing 6 or 8 inches high, blooming from February till May, and having a large solid root and an appearance somewhat like that of the hollow-rooted species.—About twenty other species have been brought to Britain, principally from Siberia and continental Europe; and nearly one-half of these are tuberous-rooted, while most of the remainder are either annuals or biennials.

CORYLUS. See NUT-TREE, HAZEL, and FILBERT.

CORYMB. Such a collection of flowers, in natural inflorescence, as produces, from peduncles of various lengths, a level floral surface like that of an umbel. All the peduncles stand upon a common longitudinal axis; but the longest are produced farthest down, the shortest are produced farthest up, and the others are produced at intermediate distances. A familiar example of a corymb occurs in the inflorescence of the mountain ash. Plants which produce their flowers in corymbs are said to be corymbiferous.

CORYNEPHORUS. See CLUB-GRASS.

CORYPHA. See FAN-PALM.

CORYZA. Inflammation of the nostrils, and mucous, excoriating, fetid, or purulent discharge from the nose, unaccompanied by cough, or by inflammation of the fauces. It naturally produces catarrh, is very frequently accompanied by it, and springs from the same causes; yet in cattle and sheep, it sometimes occurs alone, and it should then be promptly met by suitable remedies to prevent it from running into catarrh. A mash at night and two or three doses of cooling medicine will generally cure it in a cow or an ox. See the article CATARRH.

COSH. The sheath or empty pod of pease and beans, and the husks or chaff of oats and wheat.

COSMEA. A genus of ornamental plants, of the sunflower division of the composite order. Eight species were introduced to Britain between 1798 and 1836; seven of these were from Mexico, and one from South America; seven are annuals, and one is a tuberous-rooted perennial; three have respectively pink, purple, and white flowers, and four have yellow flowers; all take their name of cosmea or "the handsome," from the fine appearance of their flowers; two of the annual species, the sulphur-flowered and the small-flowered, combine hardness with beauty, and three are placed by some botanists in the elegant genus *coreopsis*. A more recently introduced species, *Cosmea tenuifolia*, carries lilac-coloured flowers, and now figures in the catalogues of the seedsmen.

COSSART, or COSSET. A lamb, a calf, or a foal which is abandoned by its dam before it can shift for itself, or which, in consequence of belonging to a twin or triad birth, cannot receive such a portion of her care as is necessary for its nurturement.

COSTÆ. See RIBS.

COSTIVENESS. An undue retention of the feces in animals, or a morbid and comparatively

inactive state of the intestinal canal. Occasional instances of this disease, as distinguished from habitual ones, are more properly designated constipation. Some of the causes of constipation in horses are violent and hard exercise, especially in hot weather, a long course of comparative inactivity in ordinary weather, and the prolonged use of hard meat without grass or other cleansing diet. The proper treatment of constipation in horses, Blaine pronounces to be, "First, back rake; next, throw up a laxative clyster; and then proceed to give a purgative by the mouth, milder or stronger according to circumstances."

But the treatment of constipation in cattle, in consequence of the long and elaborate course of digestion which intervenes between the mouth and the seat of the disorder, is much more difficult. The best method seems to be to administer Epsom salts in a series of moderate or minimum doses, and in combination with aromatics or cordials, such as ginger and caraway, giving a minimum quantity of the stimulant with the first dose, and increasing the quantity with the second dose or with subsequent doses according to the exigencies of the case. Constipation in a cow has been known to continue unrelaxed during eight days; and it ought, in every instance, to be attacked with judicious dose after dose till it gives way. Mr. Youatt very wisely remarks, in reference to the necessity for using cordials in cases of obstinate constipation in cattle: "There is something in the structure of cattle which renders certain medical rules and principles altogether inapplicable, and which, in defiance of all fever, occasionally compels us to mingle strange doses of aromatics and stimulants with the very means by which we are endeavouring to subdue inflammation."

Constipation, occasioned by coagulation of milk in the abomasum, and by the consequent distension and obstruction of that stomach, sometimes occurs in calves of a few days old; and, though this is often incurable, it may, in many instances, be cured by means of successive doses of hot solution of Epsom salts administered with the stomach-pump,—the first dose consisting of two ounces of the salts in two or three quarts of warm water, and the subsequent doses consisting each of one ounce of the salts and two quarts of warm water, and being administered at intervals of six hours till the constipation gives way. But prevention is far more important than cure, and may easily be effected by not allowing the calves to suck too much milk at a time, or to suck a cow whose milk is somewhat old, or to feed upon the indiscriminate or promiscuous new milk of the dairy.—Constipation, caused by a rapid or sudden change from such fluid and emollient food as gruel to such hard, dry, and stimulating food as hay, sometimes occurs in calves of two or three months old; and, in this case, it is attended by an overworking and overloading of the manyplices with the hard fibrous food, and

by a consequent stoppage of the process of rumination, and is not a little dangerous. The cure in this instance, as in the former—when any cure can be effected—is to administer solutions of Epsom salts by means of the stomach-pump,—the first dose to consist of four ounces of the salts in a gallon of warm water.

Constipation not unfrequently occurs among lambs and young sheep; and as it either impels them into fever or indicates them to be already fevered, it ought to be promptly and energetically attacked. Yet mere ineffectual straining of the animals to effect evacuation may indicate the very opposite disorder, or at least may be occasioned by such a clotting and adherence of the tail about the orifice of the rectum as to constitute mere external and mechanical obstruction. But when real constipation exists, and is shown, by the heaving of the flanks, the heat of the mouth, and the general restlessness of the system, to be accompanied with fever, blood should be let, purging should be induced, and the patient should be removed to green, tender, young, and succulent pasture. The means of inducing purging are similar to those for cows and calves; and each dose may consist of two ounces of Epsom salts, either a little ginger or two drachms of powdered caraway, and a sufficient quantity of warm water for perfectly free solution.

Habitual costiveness characterizes some horses, and is caused either by a defective secretion of the intestinal fluid, or by an excessive absorption of the liquid ingredients of the faecal mass, by morbid action upon either quantity or quality in the secretion of the bile, or by the excessive or constant use of beans or of any other dry and heating food. Whatever be the cause, any attempt to reduce or mitigate habitual costiveness by means of purgatives would only increase the evil; when morbid action in the secretion of the bile is the cause, the treatment must be the same as for jaundice; when the excessive use of dry food is the cause, occasional bran mashes may be given; and when the cause is wrong action in the bowels themselves, or is general or not recognizable, carrots may be given in winter, and green food in summer. But habitual costiveness may frequently exist in horses without detriment to their health, or at least may be of such a nature as to require only occasional and very partial correction. "This disorder," says Gibson, "is not easily removed; nor is it often necessary to bring such horses into a contrary habit; for where this is natural, it may proceed from a more than ordinary strength and rigidity in the small fibres of the stomach and guts, which makes them digest their aliment well, and retain their excrements longer; and when such a habit can be kept within very proper medium, the horse will continue in strength and vigour, without any inconvenience; and it is observable that these horses are, for the most part, able to endure great fatigue and labour. However, it is

proper to give such horses, at all convenient times, an opening diet."

COSTMARY,—botanically *Balsamita*. A genus of balsamically fragrant plants, of the chamomile division of the composite order. The common species, *Balsamita vulgaris*, is a native of Italy and the south of France, and was introduced to Britain soon after the middle of the 16th century. It is a hardy, perennial-rooted herb, and was formerly much cultivated, in kitchen gardens, for both culinary and medicinal purposes. Its roots are hard, fleshy, and creeping; its stems are branchy and about a yard high; its radical leaves are oval, greyish, serrated, about 3 inches long and 1½ inch broad, and grow on long foot-stalks; its stem leaves are similarly shaped to the radical leaves, but are smaller and sessile; and its flowers have a deep yellow colour, and are produced in loose corymbs at the top of the stems, and appear in August and September. The whole plant is softly and agreeably fragrant. Four other species, but all of far less interest than the common sort, may occasionally be seen in British gardens. The whole genus is very nearly allied to the tansies.

COSTUS. A genus of ornamental, tropical, evergreen, herbaceous plants, of the ginger tribe. The Arabian species, *C. arabicus*, is a native of both Indies, and was introduced to Britain about the middle of last century. Its root is fleshy, jointed, and medicinal, like that of ginger; its stems are numerous, round, tapering, herbaceous, and about two feet high; its leaves are smooth and oblong, and embrace the stems like those of reeds; its club or bract of flowers rises from among the stems, is two inches long, about as thick as a man's finger, and blunt at the top, and consists of leafy scales, out of which the flowers are produced; and each flower consists of one thin white petal, and seldom continues unwithered for a longer period than one day. This plant, as cultivated in our hothouses, has a wide and uncertain range of time of bloom, extending from summer, through autumn, to a late period in winter. Its root is pleasantly fragrant and somewhat pungent; and is used, in India, as a valuable remedy in certain stages of typhus fever, and combinedly with other medicines as a stomachic. About a dozen other species have been introduced from the tropical regions of Asia, Africa, and South America; and several more are known to botanists.

COTONEASTER. A genus of ornamental shrubs, of the rosaceous-flowered tribe. The common species, *Cotoneaster vulgaris*, formerly called *Mespilus cotoneaster*, may be found wild on some of the chalky cliffs of Wales, and is a native of Ararat, of the Pyrenees, and of many of the cold parts of continental Europe. It is closely allied to the medlar and the hawthorn genera, and has often been popularly termed the dwarf quince. Its stem attains a height of about 4 or 5 feet; its branches are few, smooth, and of a

reddish-purple colour; its leaves are oval, entire, very shortly petiolate, and deciduous; its flowers are produced in twos and threes from the sides of the branches,—and they are small and of a pinkish-purple colour, and bloom from May till July; and its fruit is spherical and of a bright red colour. But three quite distinct varieties are in cultivation,—the red-fruited, the dark-fruited, and the depressed,—*C. v. erythrocarpa*, *C. v. melanocarpa*, and *C. v. depressa*,—the last an import from Sweden.—Two other species have the same height, the same deciduous habit, and the same general character as the common species,—the loose-flowered, *C. latiflora*, introduced to Britain in 1826, and sometimes regarded as a mere variety of *C. vulgaris*,—and the woolly, *C. tomentosa*, brought from Switzerland a little after the middle of last century, and regarded by numerous botanists as a species of medlar.

The small-leaved species, *C. microphylla*, is an evergreen undershrub or ligneous trailer,—one of the most curious and beautiful in the whole of the great horticultural collections; and though introduced to Britain from Nepaul so late as 1824, it is already a well-known favourite, and in comparatively extensive cultivation. It is clothed with a glossy deep green foliage, which retain all their freshness and beauty amidst the most rigorous frost; and its flowers have a snowy-white colour, and bloom in May and June,—and they seem, while reposing on their rich couch of shining green, to resemble diamonds strewn on a bed of emerald. Its remarkably trailing habit enables it to adorn rockwork and spread an opulently ornamental covering over spots of rubbish and pieces of prostrate wall which no other elegant evergreen shrub can accomplish; and an extraordinary and powerful habit which it has been discovered to possess of pushing its shoots outward and upward in the direction of the north, gives it adaptations of a still more singular kind. Mr. Murray of the Glasgow Botanic Garden mentions a plant of it which grew over a south wall, and carried a full complement of both large and small branches to the top, without the aid of any sort of fastening; and Mr. Sim of Footscray instances a bush of it which, while it had not grown to the southward, would have extended upwards of 20 feet in a northerly direction had not its progress been arrested by the intervention of a walk. The peculiar flavour which indicates the presence of prussic acid in drupaceous plants, is so strong in the small-leaved cotoneaster, that a botanist who had never seen the plant in flower might be induced from the smell to pronounce it a prunus; yet the tribe to which the plant belongs have the reputation of secreting only the malic acid.—Two other species of cotoneaster, *C. rotundifolia* and *C. buxifolia*, are so nearly akin to *C. microphylla*, in coriaceousness of evergreen leaves, in prostrate and trailing habit of branches, and in other interesting characters, that they might almost be regarded as mere

varieties. But four other species, the frigid, the related, the elliptic, and the acuminate, are tall shrubs of from 9 to 18 feet in height, and have, for the most part, a sort of medium habit between deciduous and evergreen.

COTSWOLD SHEEP. See SHEEP.

COTTAGE. A small dwelling-house. But the word small is comparative; and while one cottage may be but a grade superior to a hut, another may be but a grade inferior to a mansion. All cottages, though almost innumerable varied in gradation, are reducible to two great classes, the ornate and the plain,—the former suited to the upper and the middle ranks of society, and the latter adapted to operatives and peasantry. Cottages of the former class are frequently designated cottages ornées, and may, according to their design or style, be subdivided into ten groups,—the suburban cottage, the English rural cottage, the pointed or Tudor cottage, the ornamental farm-house, the cottage villa in the bracketed mode, the irregular, Italian, bracketed villa, the irregular old English cottage, the Italian villa, the Tuscan villa, and the pointed or Gothic villa. But—with the exception of the ornamental farm-house, which may be noticed in our article on FARM-BUILDINGS—these structures are scarcely proper subjects of discussion for our work; and besides they are discussed at full length, professionally, and in the order in which we have grouped them, in a recent publication of no great size and of easy access, 'Downing's Cottage Residences.'

Cottages for town and country operatives, and particularly for farm labourers and small agricultural tenants, have, within the last twenty years, been very greatly improved in many parts of Great Britain, and particularly throughout the lowlands of Scotland. Almost all cottages of this exceedingly numerous and important class, were at one time constructed on principles of sheer sordid economy, with very little regard to the health or comfort of their occupants, and with no regard whatever to their self-respect and to the proper tone of their moral feelings. But a great and happy change has taken place. Multitudes of landlords and farmers have become enlightened and patriotic enough to identify their own interests, with the domestic enjoyments, the former of their tenantry and the latter of their labourers; and they have concurred in exertion to elevate the character of the people's homes, and, through this, to improve the character of the people's principles. The Highland Society, too, has strenuously exerted the whole of its powerful influence to produce a general, skilful, and rapid improvement, and, in particular, they appointed committees of inquiry, diffused the best information, gave publicity to some fine examples of cottage-building by landlords, offered many premiums throughout small districts of the country, and procured and published the best professional specifications for

erecting good agricultural cottages. Either to give a narrative of the improvements which have been effected, or to sketch a view of the present condition of cottages throughout Britain, or to describe model plans of a few good individual structures, would far outrun the limits within which we feel obliged to restrain this subject; and we shall merely give a curtailed statement of the general specifications in a prize essay by Mr. George Smith, published in No. 24 of the Highland Society's Transactions, and refer any of our readers who desire further information to that essay itself, and to other excellent papers in the 44th and 52d Nos. of these Transactions, in the 49th No. of the Quarterly Journal of Agriculture, in the 4th vol. of the communications to the Board of Agriculture, and in the 4th and 5th vols. of the Journal of the Royal Agricultural Society of England.

Mr. Smith's specifications apply altogether or very nearly to good cottages of all possible sorts in stone districts; yet we may briefly indicate the precise plans and the estimated cost of cottages, which they were expressly written to illustrate. The estimate of expense takes the stones at prime cost, and assumes the builder to afford all materials and workmanship, but to have these carted free of expense to the site. First is a single cottage, to cost £70; second, a single cottage, £75; third, a single cottage, £83; fourth, a double cottage, £130; fifth, a double cottage, £136; sixth, a double cottage, £160; seventh, a combined cottage for four families, £252; and, eighth, a combined cottage for six families, £330. The first single cottage has a kitchen and a room, each 16 feet by 12; a space of $4\frac{1}{2}$ feet between these for beds and lobby; a scullery and a closet in a lean-to behind; and a cellar and other conveniences at the rear of the scullery. The second single cottage has a kitchen and a room, each 16 feet by $11\frac{1}{2}$; a lobby and a large bed-closet between the kitchen and the room; a scullery off the end, and a light bed-closet off the middle of the kitchen; a narrow stair behind the bed-closet, leading to a loft over the whole; wall-presses in both the kitchen and the room; and cellar and other conveniences at the east end of the house. The third single cottage has a porch, an irregular plan, a sort of picturesque outline, and a convenient and comfortable interior, and might suit well for a gate-lodge or a gardener's house on a property whose mansion is in the old English style. The first double cottage has two porches in the middle of the front, placed back to back; and each of its two dwellings has a kitchen of 16 feet by 12, a scullery and a pantry in a lean-to behind, a cellar and other conveniences in the rear, and a room of 16 feet by 11, with wall closets in inside walls. The second double cottage has porches at the ends and an overhanging pavilion roof; and each of its dwellings has a tool-house behind the porch, a kitchen of 16 feet by 13, a room of 16 feet by 11, a pantry

and a cellar, a back-scullery fitted with boiler, water-pipe, and sink, and exteriorly a pig-house and a poultry-house, with yards and other conveniences. The third double cottage has a handsome elevation, and a general outline like that of a large single cottage; and each of its dwellings has a compact and convenient arrangement, comprises three apartments, with closet, scullery, pantry, cellar, and other accommodations, and has a bed-room over the centre, and a loft over the kitchen. The combined cottage for four families consists of a centre and two wings; each wing is a dwelling-house, with a kitchen of 16 feet by 12, a room of the same size, wall-presses, space for beds between the kitchen and the room, an interior scullery, and exterior cellar and other conveniences; and each half of the central compartment is also a separate dwelling-house, with a kitchen of 17 feet by 12, a back scullery, a room of 12 feet by $10\frac{1}{2}$, a pantry in the lobby, and exteriorly a yard, a cellar, and other conveniences; and two of the four dwellings have pig-houses, two have poultry-houses, and the four have combinedly a cow-house.

In digging and levelling for the erection of any of the cottages, the whole area is made uniform, and the trenches are excavated to the depth of $2\frac{1}{2}$ feet below the floor-level, and made $3\frac{1}{2}$ feet wide. The foundation-course is laid three feet broad, with large flat-bedded stones; the walls are brought in to the breadth of two feet by an offset at each side; the whole walls are built of prime rubble stones, laid on their natural bed, with properly prepared mortar; the division-walls of the double cottages are carried close up to the slates; the base-course, the corners, the rebates, the soles and lintels of doors and windows, the chimney-tops, the door-steps, and all projections, are executed with neatly broached ashlar; and the corners are broached to the breadth of six inches on each face, and back-checked half an inch for harling. All the ground floors are formed of dressed flags, neatly squared and jointed, and laid on a level stratum of lime riddlings and dry stone shivers. The jambs, lintels, and hearths of the fire-places are formed of polished stone. A dwarf wall, 12 inches thick, is built across, under each of the floored rooms, for supporting the sleeper joists; and four iron-grated openings, each 8 inches square, are made in the base-course round the floored rooms, for the circulation of air under the flooring. All the doors and windows have safe lintels, of one inch in thickness to every foot in length, and have at least nine inches of solid hold of the walls at each end. The scantling for the ties and rafters of the roof is not less than $6\frac{1}{2}$ inches broad and $2\frac{1}{2}$ thick, and is formed out of Baltic white wood battens; the cupples are set at the distances of 18 inches, on level wall plates, 7 inches by $1\frac{1}{2}$ inch; the joists of the floored rooms are 7 inches broad and $2\frac{1}{2}$ thick, and are placed at distances of 18 inches, and floored over with grooved and

tongued Dram timber 1½ inch thick; and the partition-standards are 4 inches broad and 2 thick, and are placed at distances of 16 inches, and, as well as all the ceilings, covered over with the best Baltic split lath. The outside doors are made of 1½ inch ploughed, tongued, and beaded deal, and have each on its back three cross-bars, 8 inches broad, of one inch thick deal; and all are hung with strong cross-tailed hinges, and mounted with strong stock-locks and iron lifting-latches. The window-sashes are framed two inches thick, with ¾ inch astragals, and glazed with 3d crown glass. The roofs are covered with close-jointed ¾ inch sarking, and slated with good slates from the nearest slate-quarry or slate-market; and the ridges and flanks are covered with lead, 12 inches broad, and of 5 pounds to the superficial foot. All the walls, ceilings, and partitions are finished with two coats of good plaster lime; and all the windows and outside-doors receive three coats of the best oil paint. The minor details of the interior, and all the details of the outhouses, are furnished in a neat and substantial manner, in full keeping with the character of the general masonry and carpentry.

COTTAGE ALLOTMENTS. See ALLOTMENT SYSTEM.

COTTAGE ECONOMY. The prudent, thrifty, and effective management of the domestic affairs, and particularly of the household expenses, of a peasant's family. Cobbett's well-known tract on this subject has been antiquated by the progression of society; but an excellent paper, compiled by French Burke, Esq., from essays submitted to the Royal English Agricultural Society of England, was published in the third volume of that Society's Journal, and a cheap, minute, comprehensive, and exceedingly good manual, under the title of 'The Working Man's Wife,' was recently published by the London Religious Tract Society. "To use without waste the food which Providence supplies for the wants of man," remarks Mr. Burke, "is of the greatest importance to those who have but little to spend; and nothing so completely disarms the stings of poverty as the means of rendering a scanty pittance capable of producing a comfortable meal. If, therefore, by teaching them a little of simple cookery, it can be occasionally so changed as to make it somewhat more savoury at the same cost, there can be little doubt that it would materially add to their comforts, and then attach them still more to their homes." Ample instructions on this point, and on others also of far higher importance, are contained in the Tract Society's manual; and a copy of the book may be had for a shilling. Many valuable hints, though somewhat diffusive and suited more to the peasantry of Ireland than to those of Britain, occur likewise in some of the tracts and pamphlets of Martin Doyle. See the article FARM-SERVANTS.

COTTAGE GARDENING. A small piece of garden ground affords a cottager useful employ-

ment during his hours of leisure, enables him to add greatly to his resources and his domestic comfort, and indirectly but powerfully improves his moral character, and heightens the tone of his healthy feeling of independence. But it ought not merely to be possessed by him, but wisely managed, and kept in skilful cultivation. Many cottage gardens are kept in a condition only a degree or two better than savage, indicating total ignorance of all true principles of cultivation, and displaying a barbarous indifference, not only to taste and beauty, but to the most common tidiness and order; and these, so far from really benefitting their owners, encourage their miserable habits, incite them to disregard or contemn improvement, and exert a malign influence upon the taste and progress of the surrounding community. Ill kept cottage gardens, in fact, sustain exactly the same relation to the principles and arts of cultivation, which filthy, irregular, ill-managed houses do to the principles and arts of domestic economy.

The land of a cottage garden may, from being situated on the lowest dip of the surrounding surface, or from the comparative sponginess of its soil, or from the retentiveness of its subsoil, or from the overflowings upon it of some land-spring, be too wet for the successful cultivation of kitchen vegetables; and, in every such instance, it ought to be promptly and thoroughly drained. But, in even the worst case, the digging of a ditch round the outside, and the forming of either an outlet or "a swallow" at the lowest corner, will be sufficient. When the garden adjoins a public road, or a waste, or a common field, it ought to be protected by a good hedge or by a ditch and hedge, or by a deep ditch and paling; but if it be an allotment piece, it ought not to be separated from adjacent pieces by more than a footpath, or other simple boundary line; for unless hedges are quite necessary for protection, they serve as retreats for slugs and mischievous insects. All timber and ornamental trees, particularly poplars, ash-trees, willows, alders, birches, and mountain-ashes, when growing in the hedge-rows or upon the margin of cottage gardens, are excessive intruders, and make fearful curtailments upon the amount of useful crops which might be raised. Unless a kitchen-garden, whether old enclosure or new allotment, have been quite recently trenched, a new tenant should resolve to trench it piece by piece till, within as short a period as his convenience will allow, the whole of it obtain a new surface. Trenching is indispensable for deep-rooting plants, and serviceable to the most shallow-rooting ones, it deepens the soil, and facilitates the performance of all future operations; it buries weeds and sickly mould, and converts a useless or noxious surface into a useful, root-feeding substratum; and it secures a greatly improved circulation of both air and moisture, and averts many bad effects both of excessive rain and excessive

drought. If the soil be very clayey, it ought, as speedily as convenience and opportunities will permit, to be improved by intermixture of sand and fine gravel; if very sandy, by intermixture of clay; and if boggy or very fibrous, by the intermixture of marls and calcareous gravels.

Frequent applications of manure, in some circumstances as intermixtures, in others as top-dressings, and in others as stimulating waterings, are essential to the free and constant fertility of even the richest garden land. A cottager who keeps a cow or a pig, should make the utmost of his advantageous circumstances, by procuring abundance of ferns, road-side grasses, and other litter, and by not allowing a drop of the liquid matters of the cow-house or the piggery to escape; and one who has neither a cow nor a pig should have a hollow pit in a convenient situation for receiving all drainage from his cottage and all refuse from his garden, and should add to the contents of that pit all sorts of ashes, marl, lime-rubbish, soot, road-sweepings, and cattle-droppings on lawns, or droppings which he can conveniently obtain, and should once or twice, or oftener if necessary, stir or turn over the whole to promote the requisite degree of incorporation or decomposition. Liquid manure, or the drainage of a dunghill, diluted if necessary with water, is the most effective for cabbages and borecoles, either in the seed-bed or after transplantation; and a cesspool may, in many a small holding, be very advantageously sunk for the purpose of collecting and retaining this substance.

The proportion of crops to one another and to the whole garden demands the close consideration of every occupier of a cottage garden, and ought to be regulated by the real wants and the judicious tastes of his family. The crop which remains longest in use, and yields the largest return, and is averagely of most service to a household,—in other words, the potato crop—will command the largest share of the ground; and other crops, such as cabbages, borecoles, savoy, carrots, parsnips, turnips, beans, kidney-beans, onions, leeks, potherbs, pease, salad-herbs, and a few flowering-plants, will occur in a descending series of prominence, as nearly as possible in the degree of their comparative value to the family, or very nearly in the order in which we have named them. Assuming a garden to have an area of half a rood or 20 perches, to belong to a man who has a wife and three or four children, to be disposed in a rectangle of 38 yards by 16, and to come into the possession of the tenant at Michaelmas, a rough model sketch may be given of its distribution, which will serve in some degree to direct the distribution of gardens of other sizes, or belonging to cottiers in other circumstances. One half of the garden, measured from one end to the middle, must be marked off for potatoes, and should be either trenched or well dug during winter, in order to be thoroughly mellowed and otherwise prepared for the most

profitable reception of the potato sets, in spring. Seven yards of the length, measured from the middle of the garden or end of the potato plot, should, as speedily as possible after the tenant's taking possession, be dug and planted with borecoles or some other variety of cabbage; and about the middle of January, when the second, the fourth, the sixth, and the eighth rows of the young cabbage may be supposed to have been used, the spaces where these rows stood should be pointed over with the spade, and planted with long-podded beans at distances of 4 inches. Nine of the remaining twelve yards may be disposed in four parallel beds, all to be cropped in March and April,—the first with parsnips, the second with carrots, the third with onions and leeks, and the fourth with radishes, lettuces, cabbage-seeds, early Dutch turnips, and a few potherbs, rhubarb, salad-herbs, and flowering-plants. Some other crops, such as pease and scarlet runners, can be inserted in interstices occasioned by the progressive use of cabbages, beans, and carrots; and not a few others, which are sometimes cultivated in small gardens, such as cauliflower, broccoli, celery, artichokes, pumpkins, and a dozen or so more, are quite unsuited to the economy and the frugal tastes of a well-conducted cottier family.

A most important element in the cultivation of all land is to maintain a constant and judicious rotation of cropping; and though this cannot be so easily and so steadily kept in play in a cottage garden as upon a farm, it must be sedulously observed, and is absolutely indispensable to the obtaining of full returns, and to the maintaining of prolonged fertility. In the second year, with the exception of the three-yard miscellaneous border of seed-beds, herbs, flowering-plants and other small matters, all the half of the garden which had no potatoes in the first year may be cropped with potatoes, and the part which was occupied in the first year with potatoes may be distributed into beds and sections for cabbages, beans, parsnips, carrots, and onions,—the cabbages and beans being placed next to the potatoes. In the third year, the potatoes may occupy the middle of the garden, and the cabbages and beans may occupy the quarter further removed from the miscellaneous border. In the fourth year, the potatoes may occupy their original position; and the cabbages and beans may be placed next to the miscellaneous border,—the several small crops of that border having meanwhile been made to change places within its own limits. In subsequent years, similar changes of place among the principal crops may follow one another; and at comparatively remote intervals, cleansing and most remunerating crops of wheat or barley may be grown as substitutes for the potatoes, or even, on a rare occasion, for all the crops except the very smallest.

"There is one circumstance," to quote from a very long and excellent paper by Mr. Main, in the *Journal of the Royal Agricultural Society*,

to which we have been largely indebted in the drawing up of the present article—"There is one circumstance which every manager of a garden, especially those who are confined to a limited spot of ground, should ever be well aware of; and that is the practicability of having a constantly recurring succession of crops on the same piece of ground. This is a practice which farm or rural labourers in general are but little acquainted with; though, when judiciously planned and executed, it is of the greatest advantage. Mixed crops are allowable in cottage gardening; for instance, a sprinkling of radish and cress-lettuce may be sown with the onions; and when the radish and lettuce are drawn, being ready for use, the onions suffer no injury. Broad beans are sometimes planted at the same time and in the same drill with potatoes, and without any very visible damage to the latter crop. But in order to keep the ground in full employment, all the crops, that is the standing crops, must be sown or planted in drills or rows, with the intention that, before the first crop is off, another shall be put in the intermediate spaces to follow in succession. This is quite practicable with all the cabbage tribe, or with any other kind of vegetable which may be used in *any stage* of their growth. Of this description are the cabbage, savoy, onion, lettuce, &c.; and when such are planted alternately with others, which must stand to acquire full perfection, the first may be used out of the way as soon as they press injuriously upon the second. In this way, many more useful vegetables may be raised on a given portion of land than by the old-fashioned custom of sowing broadcast, only one patch of each of the common sorts occupying the ground for the whole summer. Even the onion ground may be planted with cabbages just before the former are fit to pull, which plants, whether savoys or common cabbage, become fine useful stuff before Christmas. This constant routine of cropping and re-cropping may be considered as out of the power of a day-labourer to perform; but, whether he may have time or not, it is highly proper that he should be made acquainted with every practical matter which he may endeavour to turn to his advantage."

Both the general principles of cultivation, and the special principles applicable to each particular crop, are abundantly taught in other parts of our work; yet two or three rules, so modified as to have a very special bearing upon the management of the cottage garden, may here be stated. The soil ought to be worked with either spade or hoe, only when in a dry or nearly dry condition, and never when drenched with rain, or otherwise full of moisture. The seeds of beans should be dibbled into the ground, and the seeds of onions made firm in the soil by treading with the feet after they are sown, for both beans and onions form the most vigorous young roots in firm soil; but all other seeds should be sown in

thoroughly pulverized and pretty dry soil, and allowed to strike root in as loose and friable a texture of it as can be produced. Unless when the surface to be sown or planted is partly occupied with growing crops, every sowing or transplanting should be made in recently-dug and quite freshly stirred soil; and even on pre-occupied ground, the portions to be sown or planted ought, immediately before sowing, to be stirred to the utmost extent compatible with the interests of the growing crop. All perennial weeds ought to be carefully eradicated; and all annual weeds destroyed before they come into flower. All coarse herbage of grasses or weeds collected into the compost heap ought to be hurried into fermentation by repeated turnings, and should not be spread upon the soil till they are in a sufficiently advanced state of decomposition to afford security against their seeds germinating, and producing a crop of weeds. Small seed-beds of different varieties of cabbage, and perhaps of lettuce, or of any similar plant, should be kept up to afford a constant supply of seedlings for filling up every yard of ground as it becomes vacant. Any attempt to cultivate fruit-trees in a cottage garden is absurd; but a row of gooseberry bushes, interspersed with two or three white or red currant bushes, and arranged along the foot of the garden, is not amiss.—*Quarterly Journal of Agriculture.*—*Journal of the Royal Agricultural Society.*—*Sir John Sinclair's General Report of Scotland.*—*Martin Doyle's Works.*—*Cobbett.*—*Mawe.*—*Johnson.*—*Miller.*

COTTAGE HUSBANDRY. Either the cottier cultivation of garden or allotment plots, varying in size from two perches to two acres, but usually ranging between half a rood and two roods, or the agricultural cultivation of regularly appointed farms of very small extent, usually ranging between five and ten acres. The former is the kind of cottage husbandry which prevails in Britain, and will be found fully discussed in our articles ALLOTMENT SYSTEM, COTTAGE GARDENING, and SPADE HUSBANDRY. The latter prevails in Ireland, and, so far as it is sound in practice, or manageable on principles of true economy, is discussed concurrently with British husbandry throughout the numerous agricultural articles of our work. The defects and peculiarities of Irish husbandry exist rather in the low moral condition and comparative agricultural ignorance of the people, than in the smallness of their farms, and might easily be made to disappear without any reference whatever to supposed difference of either status or resource between the peasant-farmer who occupies a cottage upon six acres and the gentleman-farmer who occupies a fine villa upon a thousand acres. The following report by Mr. Nicholl upon the condition and practices of the peasant farmers of Belgium will throw more light upon the subject of Irish cottage husbandry than a whole volume of speculation and advice:—

"In the greater part of the flat country of Belgium, the soil is light and sandy, and easily worked; but its productive powers are certainly inferior to the general soil of Ireland, and the climate does not appear to be superior. To the soil and the climate, therefore, the Belgian does not owe his superiority in comfort and position over the Irish cultivator. The difference is rather to be sought for in the system of cultivation pursued by the small farmers of Belgium, and in the habits of economy and forethought of the people. The cultivation of the small farms in Belgium differs from the Irish,—first, in the quantity of stall-fed stock which is kept, and by which a supply of manure is regularly secured,—second, in the strict attention paid to the collection of manure, which is skilfully managed,—third, by the adoption of a system of rotation of five, six, or seven successive crops, even on the smallest farms, which is in striking contrast with the plan of cropping and fallowing the land prevalent in Ireland.

"In the farms of six acres, we found no plough, horse, or cart; the only agricultural implement, besides the spade and wheel-barrow, which we observed, was a light wooden harrow, which might be dragged by hand. The farmer had no assistance besides that of his wife and children, excepting sometimes for a short period in the harvest, when we found he occasionally hired a labourer at a franc (tenpence) per day. The whole of the land is dug with a spade, and trenched very deep; but if the soil is light, the labour of digging is not great. The stock on the small farm which we examined consisted of a couple of cows, a calf or two, one or two pigs, sometimes a goat or two, and some poultry. The cows are altogether stall-fed, on straw, turnips, clover, rye, vetches, carrots, potatoes, and a kind of soup made by boiling of potatoes, beans, pease, bran, cut hay, &c., into one mass, and which, being given to the cattle warm, is said to be very wholesome, and to promote the secretion of milk. In some districts, the grains of the breweries and distilleries are used for the cattle; and the failure of the Belgian distilleries has been reckoned a calamity to the agriculture of the country, on account of the loss of the supply of manure which was produced by the cattle fed in the stalls of these establishments.

"The success of the Belgian farmer depends mainly upon the number of cattle which he can maintain by the produce of his land, the general lightness of the soil rendering the constant application of manure absolutely necessary to the production of a crop. The attention of the cultivator is always, therefore, especially directed to obtain a supply of manure. Some small farmers, with this view, agree with a sheep-dealer to find stall-room and straw for his sheep, to attend to them, and to furnish fodder at the market price, on condition of retaining the dung. The small farmer collects in his stable, in a fosse lined with brick,

the dung and urine of his cattle. He buys sufficient lime to mingle with the scourings of his ditches, and with the decayed leaves, potato-tops, &c., which he is careful to collect in order to enrich his compost, which is dug over two or three times during the course of the winter. No portion of the farm is allowed to lie fallow; but it is divided into six or seven small plots, on each of which a system of rotation is adopted; and thus, with the aid of a sufficient quantity of manure, the powers of the soil are maintained unexhausted, in a state of constant activity. The order of succession in the crops is various; but we observed on the six-acre farms which we visited, plots of potatoes, flax, rye, carrots, turnips or parsnips, vetches and rye, for immediate use as green food for the cattle. The flax grown is heckled and spun by the farmer's wife, chiefly during the winter; and we are told that three weeks' labour at the loom, towards the spring, enables them to weave into cloth all the thread thus prepared. The weavers are generally a distinct class from the small farmers; though the labourers chiefly supported by the loom, commonly occupy about an acre of land, sometimes more, their labour upon the land alternating with their work at the loom. In some districts, we are informed, every gradation in the extent of occupancy, from a quarter or half an acre to the six-acre farm, is to be found; and, in such cases, more work is done in the loom by the smaller occupiers.

"The labour of the field, the management of the cattle, the preparation of manure, the regulating the rotation of crops, and the necessity of carrying a certain portion of the produce to market, call for the constant exercise of industry, skill, and foresight among the Belgian peasant farmers; and to these qualities they add a rigid economy, habitual sobriety, and a contented spirit, which finds its chief gratification beneath the domestic roof, from which the father of the family rarely wanders in search of excitement abroad. It was most gratifying to observe the comfort displayed in the whole economy of the households of these small cultivators, and the respectability in which they lived. As far as I could learn, there was no tendency to the subdivision of the small holding; I heard of none under five acres, held by the class of peasant farmers; and six, seven, or eight acres, is the more common size. The provident habits of the small farmers enable them to maintain a high standard of comfort. Their marriages are not contracted so soon as in Ireland; and the consequent struggle for subsistence among their offspring does not exist."

COTTON. A soft, vegetable down, which is contained in the seed-vessels, and envelopes the seeds, of the cotton plant, *Gossypium herbaceum*, which is cultivated in the East and West Indies, North and South America, and Egypt; in fact, in most parts of the world which possess a sufficiently warm climate. It is an annual plant. It

grows to a considerable height, and has leaves of a bright green colour, marked with brownish veins, and each divided into five lobes. The flowers have only one petal in five segments, with a short tube, and are of a pale-yellow colour, with five red spots at the bottom. The cotton pods are of somewhat triangular shape, and have each three cells. These, when ripe, burst open, and disclose their snow-white or yellowish contents, in the midst of which are contained the seeds, in shape somewhat resembling those of grapes. The fibres of cotton are extremely fine, delicate and flexible. When examined by the microscope, they are found to be somewhat flat, and two-edged or triangular. Their direction is not straight, but contorted, so that the locks can be extended or drawn out without doing violence to the fibres. These threads are finely toothed, which explains the cause of their adhering together with greater facility than those of bombax and several apocynæ, which are destitute of teeth, and which cannot be spun into thread without an admixture of cotton. In the southern states of the American Union, the cotton cultivated is distinguished into three kinds: the *nankeen cotton*, so called from its colour, the *green seed cotton*, producing white cotton with green seeds, and the *black seed cotton*. The two first kinds grow in the middle and upper country, and are called short staple cotton; the last is cultivated in the lower country, near the sea, and on the isles near the shore, and produces cotton of a fine, white, silky appearance, very strong, and of a long staple. Cotton was found indigenous in America.

There are two machines for cleansing cotton from the seeds; these are, the roller-gin and the saw-gin. The essential parts of the first are two small cylinders, revolving in contact, or nearly so. The cotton is drawn between the rollers, while the size of the seeds prevents them from passing. The saw-gin, invented by Mr. Whitney, is used for the black-seed cotton, the seeds of which adhere too strongly to be separated by the other method. It is a receiver, having one side covered with strong parallel wires, about an eighth of an inch apart. Between these wires pass a number of circular saws, revolving on a common axis. The cotton is entangled in the teeth of the saws, and drawn out through the grating, while the seeds are prevented by their size, from passing. The cotton thus extricated is swept from the saws by a revolving cylindrical brush, and the seeds fall out at the bottom of the receiver.

COTTON-GRASS, — botanically *Eriophorum*. A genus of hardy, herbaceous, grassy-looking, perennial-rooted plants, of the cyperaceous or sedge tribe. Their botanical name signifies "wool-bearer;" and both this and the popular name allude to a profuse woolly accompaniment of their seeds. The slender and the headed species, *E. gracile* and *E. capitatum*, the former about 6 inches high, and flowering in July

and August, and the latter about 10 inches high, and flowering in August and September, grows wild on the mountains of Scotland; the downy species, *E. pubescens*, flowering from May till July, and possessing a handsome appearance, grows wild in the bogs of England; the many-spiked and the narrow-leaved species, *E. polystachyon* and *E. angustifolium*, the former flowering in June and July, and the latter flowering in April, grow wild in the bogs of both Scotland and England; the sheathed or hare's-tail species, *E. vaginatum*, flowering in March and April, grows wild on the moorish grounds of Britain; and the Virginian species, *E. virginicum*, flowering from May till August, was introduced, about a quarter of a century ago, from North America. All these species excepting the two Scottish ones, usually attain a height of about 12 or 14 inches. Two other species have been scientifically described.

The two early-flowering species, *E. angustifolium* and *E. vaginatum*, afford sheep and depastured cattle a little nourishment in early spring, or previous to the growth of sufficient herbage of the grasses; but though eaten by these animals, they are not well relished, and contain a very small amount of nutritive matter relatively to their whole bulk. On bog soil, in the Woburn experiments, *E. angustifolium* yielded per acre 8,167 lbs. of entire produce, and 319 lbs. of nutritive matter, and *E. vaginatum* yielded 6,806 lbs. of entire produce, and 212 lbs. of nutritive matter. These two species, if cultivated or at least freely propagated on such high boggy ground as is useless for any other purpose and would not repay the costs of reclamation, might probably yield profitable crops of their cottony or woolly matter for the manufacture of yarn and cloth. About 16 or 17 years ago, some specimens of stocking-yarn and of remarkably firm and beautiful russet cloth were manufactured, under the direction of Mr. Helliwell of Greenhurst-Hey, near Todmorden, from the wool of cotton-grasses grown on his estate; and a calculation was at the same time made that this wool might, without cultivation, be obtained from many parts of Stansfield Common, in the vicinity of Todmorden, at the cost of not more than 2d. or 3d. per pound, and in quantity of two or three hundredweights per acre.

COTTON THISTLE, — botanically *Onopordum*. A genus of hardy, herbaceous plants, of the thistle division of the composite order. The common species, *Onopordum Acanthium*, is a large and handsome biennial British weed of gravelly banks, and gravelly wastes, and sometimes of rich lands and even of dunghills. Its leaves are produced in the first year; they are numerous, large, downy, prickly, and sinuated; and they spread on the ground, and continue throughout the winter. Its stem rises in spring from among the middle of the leaves; it usually, on good soil, attains a height of about six feet; and it ramifies upward into many branches, which have leafy borders or

edgings, marked with indentations and spines. The flowers are produced in scaly heads at the top of the stem, and they have a purple colour, and appear in July and August; and the seeds are oblong and angular, and are crowned with a hairy down, which wafts them far and wide upon even gentle breezes, and occasions the plant, if not kept down, to become a rapidly multiplying and exceedingly troublesome weed. Twelve species have been introduced from foreign countries, chiefly countries bordering on the Mediterranean; but these species, though either curious or handsome, are seldom to be seen in Britain except in botanic gardens.

COTULA. See MAY-WEED.

COTYLEDON. A genus of plants. See NAVELWORT.

COTYLEDON. The lobe or leaf of a seed. All plants which propagate themselves from spores or sporules, and have no seeds and consequently no cotyledons, are called in Jussieuan botany acotyledonous; all which have one-lobed seeds are called monocotyledonous; all which have two-lobed seeds are called dicotyledonous; and all which have seeds with more than two lobes are called polycotyledonous. The acotyledons are very nearly coextensive with the cryptogamia or agamous plants of the artificial systems of botany, or with the cellulares or the endogens of the natural system; and in consequence comprise all the groups whose means of propagation are obscure, and whose general organization is comparatively simple. The seed of an ordinary monocotyledon is nearly cylindrical, with both ends obtuse, and has the axis of growth so completely in the interior as to be observable only when the seed is broken up or cut asunder; the seed of a dicotyledon is very differently shaped in different plants, and has the axis of growth between its two lobes as between two planes, and allows this to be readily observed, and the lobes to be easily separated; and the seed of a polycotyledon has the lobes opposite to one another in a whorl;—but polycotyledonous plants are so few in number as to be generally classed with the dicotyledonous plants.

A cotyledon is a natural storage of nourishment for the developing embryo of a plant; and it feeds and nourishes the plantlet up to the stage of its acquiring organization and strength to draw sustenance from the juices of the soil and the gases of the atmosphere. It originally contains an excess of carbon; it afterwards imbibes oxygen, forms and discharges carbonic acid, and transmutes its starchy or highly carbonaceous matter into saccharine juices; and it sends off these juices into the nascent circulation, and for the initial sustenance of the plantlet. Some cotyledons, especially those which contain a comparatively large body of starchy matter, such as the acorn and the common pea, perform the whole of their functions under ground, and are thence designated *hypogæan*; and others, espe-

cially those which contain a comparatively small amount of starchy matter, such as the seeds of radishes and lupines, ascend rapidly on the plumule to the surface of the ground, there to assume the character of leaves, and to complete their functions by inhaling carbonic acid and fixing carbon, and are thence designated *epigæan*.

COUCH-GRASS,—botanically *Agropyrum repens*. A most troublesome, vivacious, rapidly-spreading, perennial-rooted weed, of the field-wheat genus. Till Beauvois constituted the recent genus *agropyrum*, this plant was called *Triticum repens*; and even yet, it is very often thus designated. Six well-defined varieties of it grow wild in Britain,—the corn-field variety, *A. r. arvense*; the subulate variety, *A. r. subulatum*; the thicket variety, *A. r. dumetorum*; the capillary variety, *A. r. capillare*; Leers's variety, *A. r. Leersianum*; and Vaillant's variety, *A. r. Vaillantianum*. Each of these has usually a height of about 20 inches, and flowers in July and August. Three other grasses, also, of totally different genera, frequently share at once the name, the mischievousness, and the denunciation of couch-grass,—the creeping agrostis, or black twitch, *Agrostis repens*; the creeping-rooted soft-grass, *Holcus mollis*; and the smooth-stalked meadow-grass, *Poa pratensis*.

The field variety of creeping *agropyrum*, *A. r. arvense*, however, is *par excellence* the couch-grass of arable land,—the abhorred and dreaded couch of the farmers of England, and the baffling and desolating quick-grass or scutch-grass of the husbandmen of Ireland. It is sometimes called, by the British, field-wheat, from the resemblance which its young shoot or grassy blade presents to the young shoot of true wheat; and by the French, chiendent or dog's-tooth, either from the outline of its shoot being somewhat like that of a canine tooth, or from the circumstance that dogs instinctively eat it to make them purge and vomit. Its root is creeping and jointed, grows with great rapidity, and sends up a new plant from every new joint which it acquires; its culm or seed-stem grows erect, but is not nearly so characteristic of the plant as the roots and shoots; and its seed-spike consists of a middle rachis and alternate floscules,—each of the latter, when the plant attains maturity, producing three or four chaff-protected seeds. On light and porous soils, the plant propagates itself with such prodigious rapidity by the roots, as speedily to overrun a whole field, and as to prevent its own culms from acquiring sufficient nourishment to mature the whole or even a considerable proportion of their seeds; but in very stiff soils, it makes comparatively little way amidst the strong resistance of the firm land, and, in some instances, propagates itself not more rapidly by its roots than by its seeds.

The existence or rather despotic usurpation of couch-grass on a farm, is as disgraceful to the tenant as the prevalence of docks or thistles; and when let in by a previous tenant, occasions enor-

mous labour and very serious loss to a wise and diligent successor. A field of light and porous soil overrun with this weed, must, when in a dry state, in summer weather, be ploughed up with a deep ploughshare, pulverized with the roller, swept with the harrows or couch-rake, and as thoroughly cleansed as possible with the grubber or with long-tined heavy harrows,—all the couch-roots brought to the surface being carefully removed to at least the headlands, or, more wisely, to the farmery; and—as many joints and small pieces of the roots are unavoidably broken off by the implements, and left in the soil, and would, if not smothered, very speedily produce a new growth of the weed—the field must next be laid down to grass, and kept, during several years, in a state of depasturement with sheep and cattle. A field of very stiff clay overrun with couch-grass may be reclaimed with much more ease and cheapness; for, unless in some extraordinary instances, it needs but to have the weed buried at a depth of about nine inches, either by means of trench-ploughing, with ordinary ploughs, or by means of a single-furrowing with a heavy, four-horse, deep-cutting, old-fashioned, turn-wrist plough.

The roots of couch-grass, when gathered in the process of cleaning, are usually burnt by British farmers; but they would be quite as thoroughly destroyed, and would yield vastly more manurial matter, if decomposed by means of lime. In Rome and Naples, however, they are extensively used, either in a simply washed condition, or in a state of mixture with carrots, as food for horses; and in Britain, they might be given raw to pigs, steamed or boiled to horses and cattle, and washed, macerated, and manufactured into farina for human beings. They contain nutritive matter of the same kind and nearly in the same proportion as potato tubers; they readily yield up that matter into the culinary and desirable form of a starchy powder resembling arrow-root; and on arenaceous grounds in remote districts, far from good markets or from the best resources of husbandry, they might probably afford profitable returns as a crop,—especially as they would require no other cultivation than to be coaxed into rapid ramification, and allowed ample scope to choke and kill antagonistic weeds.

COUGH. A forcible expulsion of air from the chest, or a violent effort of the diaphragm and the intercostal and abdominal muscles, to remove some obstruction to the perfectly free passage of the gases in breathing. It is not a disease, but the symptom of some one or more of many diseases; it varies in character according to the nature of the particular disease with which it is connected; and, in any instance, it can be safely interfered with or healthily removed, only by attacking and curing the disease or diseases which occasion it. Coughs of different kinds attend almost all diseases of the respiratory organs, from the slightest to the most deadly,—catarrh, pneu-

monia, pleura, phthisis, asthma, and, what in horses, are called thick wind and broken wind; and they not only indicate the existence of these diseases, but, by their different kinds of sounds, actions, and sympathies, materially assist the professional observer to distinguish each of the diseases from the rest. Other coughs, especially such as are chronic or of long continuance, are occasioned by diseases which might seem to have little or no special connexion with the air passages,—particularly by diseases of the liver, diseases of the stomach, irritations of the intestinal canal, and a great variety of nervous disorders; and not a few of these coughs are exceedingly perplexing to practitioners, and sometimes afford occasion for shrewd, far-sighted, and powerful exercise of professional skill.

Nervous or spasmodic coughs are, of course, far more numerous and diversified in the human subject than in horses and cattle; but coughs of other kinds are perhaps quite as many and troublesome. "But besides these cases," remarks Blaine in reference to the horse, "there exists at times, without any attendant difficulty of breathing (the horse at the same time eating well and thriving), a permanent cough, usually more considerable in the morning and evening, after meals, particularly after drinking, or on first going out to exercise. A cough of this description is very common, and it will remain in this state, without otherwise affecting the horse, for years, sometimes even his whole life. In other instances, it does not end in so harmless a manner, but, upon any occasional cold taken, becomes more aggravated; and each cold makes it worse and worse, until at length, by repeated attacks on the bronchiæ, the ultimate ramifications become congested and thickened with coagulable matter, and the respiration or 'wind' is at last permanently affected." But such a cough as this, even before affecting the horse's "wind," though usually spoken of as a disease under the name of chronic cough, is really a symptomatic disorder of very diversified cause and nature, and ought to be attacked only through the disease which occasions it; and when it develops itself into severe or permanent injury of the respiration, it becomes identified with what farriers call thick-wind and broken-wind. See the articles THICK-WIND, BROKEN-WIND, CATARRH, CONSUMPTION, and several others.

COULTER. See PLOUGH.

COUMARIN. The peculiar odoriferous principle of the tonquin bean. The tropical, ever-green, leguminous tree which produces that bean is variously designated by botanists *Dipterix odorata*, *Baryosma Tongo*, and *Coumarouna odorata*; and from the last of these generic designations is formed the name of the bean's peculiar principle. This substance is white, hotly pungent, and peculiarly aromatic; it crystallizes sometimes in square needles, and sometimes in short prisms; and, though neither acidulous nor alkaline, but

allied in nature to the essential oils, it has been mistaken by some chemists for benzoic acid.

COURBARIL. See LOCUST-TREE.

COVER, or COVERT. A piece of ground or a small district sheltered with thickets, under-wood, or forest. The word is used chiefly in sportsmen's language, and particularly designates the retreat of the fox or of other beasts of chase. Covers are sometimes artificially raised with mixtures of broom and gorse.

COW. The female of the bull, or of the species *Bos Taurus*. All the most valuable, curious, or otherwise interesting varieties of the cow's species, are noticed in the article CATTLE; the laws and practices which regulate the improvement or deterioration of any of her varieties, are noticed in the article BREEDING; the criteria of her age, or of the successive years of her individual being, are noticed in the article AGE OF ANIMALS; the phenomena, necessities, and diseases attendant on her propagation of her species, are noticed in the articles GESTATION, ABORTION, and PARTURITION; the diseases to which she is subject in common with the bull and the ox, are noticed in the articles BLACK-WATER, CATARRH, CONSUMPTION, HOOVE, DIARRHŒA, and many others; the proper treatment of her offspring is noticed in the articles CALF and Ox; and the right management of her produce, as well as the economy connected with it, is noticed in the articles DAIRY, MILK, BUTTER, and CHEESE. The only topics, therefore, which fall to be discussed in the present article, are few in number, and such as refer to the cow's 'points,' habits, and feeding.

The 'points' of a cow, or the marks by which she is characterized as a good milker, are very far from being identical with the 'points' of an ox, or the marks by which he is characterized as a profitable fattener. A rule or set of rules for judging of the milking qualities of cows, was, about seven or eight years ago, submitted by a M. Guénon, a landowner at Libourne, to the Minister of Public Works and Agriculture in France, and was found, on examination, to be original, feasible, probably of some value, and certainly worthy of farther investigation; but, for reasons of deference to M. Guénon, it was studiously concealed at the time, and, so far as we know, it still continues secret, or, at all events, has not found its way to the notice and approbation of agricultural associations. Many other rules have been proposed and tested, but with exceedingly little practical advantage. M. Bous-singault, as appears to us, judiciously and conclusively settles this matter in the following few sentences: "I have already had occasion to say, that the signs by which the qualities of kine as milkers were sought to be appreciated are somewhat deceitful. Still I am far from denying that practice and experience do not enable many persons to pronounce with some certainty upon this particular. The power of doing so, however, is

in some sort the peculiar privilege of him who possesses it; at least I have seen all the general rules that have been laid down on the subject fail; I have seen cows of the most opposite conformations productive. I have also said that race or descent had much to do with this quality; the heifer that comes of a mother a good milker, will be very likely to turn out a good milker also. The legitimate way, therefore, of obtaining a good race of milch-kine is to breed them from a stock that is already noted in this respect. At the time of my penning these lines, there are two animals on the farm that are remarkable as milch-kine; one is a tall unseemly animal, the bones projecting, and altogether thin and miserable; the other is a small cow with rounded outlines everywhere, the bony frame but little conspicuous, her skin soft, her hair sleek and fine; nevertheless, these two animals have one character in common,—the udder is of extraordinary size." Yet all or most cows of some breeds are very decidedly distinguished from all or most of the cows of other breeds, not only in conformation, bulk, and kindliness, but in both the quantity and the quality of their milk. Heifers specially intended for the dairy ought to be selected first from a primely milking breed, such as the short-horns or the Ayrshire, and next from among the offspring of decidedly superior milkers of that breed, yet only from among such a portion of the breed as is already on the estate or farm on which they are to be kept, or at least as are on an estate in the near vicinity of the farm, and of somewhat inferior quality of pasture. When a heifer is removed to a distance from her native spot, she is liable to suffer some deterioration of her properties as a milker; and when she is removed to pastures not quite equal or even decidedly superior to her natal ones, she is almost certain to suffer serious detriment to these properties. But no heifer should be condemned if she milks rather indifferently after her first calf; for many a prime cow somewhat slowly develops her milking properties, and does not possess them in all their amplitude till she attains her fifth or sixth year.

The quantity of milk yielded by cows greatly varies, not only with the breed and the immediate lineage of individuals, but with their age, their situation, their treatment, and especially their food. Cows grazing at liberty in South America do not give more than about three pints per day; and cows either wholly stall-fed or alternately stall-fed and grazed on rich pastures in Europe, yield all gradations of quantity, from the scanty amount of the wild cow to about 30 or 35 pints. Instances of particular cows have occasionally been mentioned so very large, and so far exceeding ordinary experience as to seem addressed more to our credulity than to our belief. Mr. Crud asserts that cows of large size have yielded 70 pints per day. Thær records that persons worthy of credit have stated the produce of some prime cows on prime pastures to be from

74 to 82½ pints per day; and some dairymen and herdsmen frequently astonish and amaze their neighbours with accounts quite as boastful of the produce of some individuals in their herds. But even when a very extraordinary yield of milk is real and unquestionable, it is characteristic less of particular cows than of particular circumstances, and rarely continues through a series of weeks or even through a tolerable series of days; and the aggregate yield, on good farms and dairies, throughout the year, may be stated as ranging from about 3,000 to about 9,000 pints. M. Perault estimates the quantity at 2,992 pints; M. Boussingault, at 4,368 pints; Mr. Low, at 5,994 pints; and Mr. Curwen, at 6,580 pints. Grogner, in the Lyonnais, states the quantity from cows ill-fed in winter at 1,284 pints; D'Angeville, at Lompries in France, from stall-fed cows, at 1,610 pints; De Dombasle, at Roville in France, from stall-fed cows, at 2,492 pints; Thaer, at Maeglin in Prussia, from stall-fed cows, at 2,648 pints; Burger, in Carinthia in Austria, from well-fed cows, at 2,752 pints; D'Angeville, in Switzerland, from stall-fed cows, at 2,992 pints; Thaer, in the neighbourhood of Berlin, at 3,004 pints; Schmalz, at Altenburg in Saxony, at 3,412 pints; Schwertz, in the low countries of Holland, from cows kept in the house during winter, at 3,400 pints; Schwertz, in Belgium, from cows at grass and in the house, 3,967 pints; Schwertz, at Antwerp, from cows ill-fed in winter, at 4,495 pints; D'Angeville, at Hofwyl, in Switzerland, from well-fed cows, at 4,685 pints; Aiton, in the low countries of Holland, at 7,066 pints; and Schwertz, at Campine in Holland, at 9,313 pints. These wide diversities of statements, as well as some of the excessive and almost incredible occasional accounts of the produce of particular cows, partly, and perhaps in no inconsiderable degree, arise from loose and erroneous methods of measuring the milk. The only true way of securing accuracy of calculation, is to take the quantity of milk yielded by each cow between her period of calving in one year and the same period in next year; and to measure the produce of each milking in a graduated pint measure, carefully noting the number of whole pints and of parts of a pint. The season of the greatest flow of milk, as affected by the physiological condition of the cow, is the first three months after calving; and the season of greatest flow, as affected by climate, weather, and facile supply of the best food, is the months of June, July, and August.

The sapidness and flavour both of milk itself and of the butter manufactured from it are powerfully affected by the quality and proportion of aromatic proximate principles present in the food of cows. The milk and the butter from the green, succulent, fragrant herbage of spring and summer are always more grateful to the smell and delicious to the palate than the milk and the butter from the comparatively dry and in-

odorous food of winter. Certain rare grasses and rare herbs on particular pastures also exert a great controlling power over the good or bad flavour of milk and butter; and several vegetables and vegetable roots are known to the dairymen and farmers of all grazing districts as imparting to milk and butter so special an aroma, that the mere flavour of the produce distinctly indicates the nature of the food. But all or very nearly all the aroma-yielding principles of such vegetables are strictly volatile, and can neither be extracted by chemical manipulation, nor preserved by any known process of drying and storing; so that only such are available for winter-feeding as reside in stems or roots which can be preserved in a succulent condition. So far as regards the flavour of milk and butter, therefore, exceedingly much depends both on the kind of food given to cows, and on the precise condition of growth or freshness in which it is used.

As respects the quantity and the chemical composition of milk, however, surprisingly little influence is exerted by either the kind or the physiological condition of the food, or by any circumstances connected with it except the proportion of its nutritiveness and the degree of its digestibility. The controlling power of particular sorts of food over the milking properties of the cow, has been almost everywhere a topic of boastful declamation and pseudo-scientific discussion among the illiterate philosophers of the dairy; but this alleged power has either been mistaken for some overlooked and widely different controlling cause, or has existed only in the heated fancy and distorted observations of its advocates. "I believe," says Boussingault, "that the influence of particular kinds of forage on the production of milk is often greatly exaggerated. Each breeder or feeder seems to have his own favourite article, however, so that there is nothing like uniformity among them. With one, it is the carrot that is in the ascendant; with another, it is the beet that is supreme; there is no root, in fact, which has not alternately had its apologists and detractors. The truth lies between the extremes here as it does in so many other instances; and I am satisfied that each and all of the roots and other articles of forage that are generally introduced into the ration of milch-kine, are calculated to produce abundance of good milk; it is only necessary that the substances be allowed in ample quantity, and that no mistake be committed in regard to the nutritive equivalents of the several articles. I do not hesitate to add that the opinions of the generality of farmers and dairymen on the subject are based on observations which are always more or less imperfect." Great variations, ranging from almost nothing to the greatest copiousness, certainly do occur parallelly with changes and successions of articles of food; but, if careful comparison be made of the bulk of the several articles, and especially of their relative proportion of nutritive matter, these variations

will, in every instance, be found to arise either wholly or almost wholly from increase or diminution of absolute nourishment. A cow kept through winter upon mere straw will cease to give milk, and when fed in spring upon green forage will give a fair quantity of milk; but she owes the cessation and the restoral of the secretion to respectively the diminution and the increase of her nourishment, and not at all to the change of form or of outward substance in which the nourishment is administered. Let cows receive through winter nearly as large a proportion of nutritive matter as is contained in the clover, lucern, and fresh grasses which they eat in summer; and—no matter in what precise substance or mixture that matter may be contained—they will yield a winter's produce of milk quite as rich in caseous and butyraceous ingredients as the summer's produce, and far more ample in quantity than almost any dairyman with old-fashioned notions would imagine to be possible. The great practical error on this subject consists, not in giving wrong kinds of food, but in not so proportioning and preparing it as to render an average ration of it equally rich in the elements of nutrition, and especially in nitrogenous elements, as an average ration of the green and succulent food of summer.

Assuming 33 lbs. of meadow hay per day to be the proper ration for a milk-cow, and referring to the article Food for a view of the elements of nutrition in the various substances usually given to cattle, and of the bulk or weight of each of these which is equal in nutrimental value to 33 lbs. of meadow hay, we may rapidly follow M. Boussingault through a course of well-conducted experiments by which he ascertained the controlling power of different kinds of food over the quantity and the chemical constitution of milk. One cow, who was 200 days after calving and was again pregnant, and who therefore was in a physiological condition to fall gradually and even rapidly away in her produce of milk, was subjected to seven distinct courses of feeding, in periods of from 7 to 14 days, and was found, during all the courses, and notwithstanding very wide diversity in the substances of their food, to yield milk of almost exactly uniform chemical constitution. She first, during seven days, received daily, 33 lbs. of hay, and she then yielded milk consisting of 3.0 per cent. of caseum, 4.5 of butter, 4.7 of sugar of milk, 0.1 of ash of caseum, and 87.7 of water; she next received daily, during eight days, turnips equal to 29.7 lbs. of hay, and straw equal to 3.3 lbs. of hay, and she then yielded milk consisting of 3.0 per cent. of caseum, 4.2 of butter, 5.0 of sugar of milk, 0.2 of ash of caseum, and 87.6 of water; she next received daily, during fourteen days, field beet equal to 29.7 lbs. of hay, and chopped straw equal to 3.6 lbs. of hay, and she then yielded milk consisting of 3.4 per cent. of caseum, 4.0 of butter, 5.3 of sugar of milk, 0.2 of ash of caseum, and 87.1 of

water; she next received daily, during eleven days, raw potatoes equal to 29.7 lbs. of hay, and chopped straw equal to 3.6 lbs. of hay, and she then yielded milk containing 3.4 per cent. of caseum, 4.0 of butter, 5.9 of sugar of milk, 0.2 of ash of caseum, and 86.5 of water; she was next, in consequence of the heating effect of the last regimen, and for a reason affecting the quantity of her produce, returned for thirty days to her original diet of 33 lbs. of hay per day,—she was afterwards fed for ten days on the same ration of potatoes and straw as before the return to the hay, but with the addition to each day's allowance of about 2½ ounces of salt,—and she was next fed for a time on a quantity of Jerusalem artichokes equal to 33 lbs. of hay per day, and she then yielded milk consisting of 3.3 per cent. of caseum, 3.5 of butter, 5.5 of sugar of milk, 0.2 of ash of caseum, and 87.5 of water. The average daily quantity of milk during the first course of hay was 9.34 pints; during the course of turnips and cut straw, 10.5 pints; during the course of field beet and chopped straw, 9.8 pints; during the first course of raw potatoes and chopped straw, 8.7 pints; during the second course of hay, 6.2 pints; during the second course of raw potatoes and chopped straw, 5.9, or very nearly 6 pints; and during the course of Jerusalem artichokes, slightly above 6 pints. The grand result, therefore, is that the chemical constitution, or what is popularly called the richness of the milk, was not appreciably affected by alternations and very great changes of diet,—that the quantity of the milk was affected principally by the physiological condition of the cow, and perhaps slightly by some circumstances which are not noticed in the record of the experiments,—and that the main point, in altering the diet of a cow, is to take care that she receive a full allowance of nutritious food, and in consequence have wherewith to secrete, not only all the ordinary juices, but as much milk as the state of her system will admit.

But two points of considerable importance remained to be ascertained,—whether the milk soon after calving differs in chemical constitution from milk at a remote period after calving, and whether fresh-cut clover exerts any such power upon the butyraceous richness of either recent or remote milk as is confidently ascribed to it by the great majority of dairymen. A cow, 24 days after calving, and while fed upon a mixture of hay and green clover, yielded at the rate of 18.6 pints of milk per day, consisting of 3.0 per cent. of caseum, 3.5 of butter, 4.5 of sugar of milk, 0.2 of ash of caseum, and 88.8 of water; and the same cow, 35 days after calving, and while fed upon green clover, produced 21.2 pints of milk per day, consisting of 3.1 per cent. of caseum, 5.6 of butter, 4.2 of sugar of milk, 0.3 of ash of caseum, and 86.8 of water. A sudden and extraordinary increase in the proportion of butter appeared in the second of these analyses; and to

ascertain whether this was ascribable to the clover, the experiment was extended through three subsequent stages. The cow was long kept on a daily ration of $16\frac{1}{2}$ lbs. of hay and a quantity of potatoes equal to $16\frac{1}{2}$ lbs. of hay, and, from the 176th to the 182nd day after calving, she produced 16.3 pints of milk per day, consisting of 3.3 per cent. of caseum, 4.8 of butter, 5.1 of sugar of milk, 0.3 of ash of caseum, and 86.5 of water; she was next kept, for eleven days, on a daily ration of $16\frac{1}{2}$ lbs. of hay and a quantity of clover equal to $16\frac{1}{2}$ lbs. of hay,—and she was then kept, for some time, on a daily ration of unmixed clover equal to 33 lbs. of hay,—and, during the latter period, she produced 17.2 pints of milk per day, consisting of 4.0 per cent. of caseum, 2.2 of butter, 4.7 of sugar of milk, 0.3 of ash of caseum, and 89.7 of water. Thus, in the early part of the experiment, a change from hay and clover to clover alone was attended with an *increase* of butter from 3.5 to 5.6 per cent.; and in the later part of the experiment, a translation from potatoes and hay, through clover and hay, to clover alone, was attended with a *decrease* of butter from 4.8 to 2.2 per cent. “The small quantity of butter in this last instance,” says M. Boussingault, “induced me to repeat the analysis; but the result came out very nearly the same, the quantity being still but 2.35 per cent.” Nor after the experiment was prolonged did any light arise either in favour of the alleged power of clover or against it; for when the cow continued to be fed on clover beyond the 204th day after calving, she produced 13.7 pints of milk per day, consisting of 3.7 per cent. of caseum, 3.5 of butter, 5.2 of sugar of milk, 0.2 of ash of caseum, and 87.4 of water. “It would therefore appear,” says the learned, indefatigable, practical experimenter, “that fresh-cut clover has no such virtue as that of increasing the quantity of milk given by cows. Under the winter fare, in fact, the milk produced in the course of the 24 hours, amounted to 16.7 pints; under green clover, it was but 14.9 pints. It would be a great mistake, however, as I conceive, to ascribe the diminution here to the use of the green forage; it is due, I apprehend, exclusively to the greater length of time that had elapsed from the period of calving. The chemical composition of the milk varied little. The differences in respect of the caseum, by which, let me say, I understand the whole of the azotized constituents, the whole *flesh* of the milk, rarely exceeded one-hundredth part. The proportion of the fatty element varies suddenly, and as it seems independently of the various circumstances in which the cows are placed. The general inference from these experiments, then, is that the nature of the food does not exert any marked influence on the quantity and chemical constitution of the milk, if the cows but receive the proper nutritive equivalents of the several sorts of provender.”

Cows, then, ought always to be maintained in

good condition. When they are ill-fed in winter, they not only cease to give a due proportion, or even any proportion whatever, of milk, but they become so thin in their ordinary juices and so reduced in their whole substance, that, when restored in spring to a fair degree of feeding, they spend, in filling up the waste of their system, a large proportion of the time and the food which would otherwise be employed in the secretion of milk; and when they decline into poor condition during the months or even weeks immediately preceding their calving, they afterwards experience so severe and prolonged a struggle between the process of secretion for making up their own substance and the process of secretion for supplying milk, that they will yield a comparatively small or decidedly scanty produce throughout even the best portions of the following season. They ought, during the whole winter, to be well-fed, comfortably housed, abundantly littered, regularly supplied with clean water, occasionally combed, and in general treated with considerate and kindly regard to their sympathies, susceptibilities, and wants.

Cows, during summer, may either be milked in the field, or driven gently home and milked in the stall. Frequent milking, at perfectly regular intervals, is essential to the maintaining of a regular secretion of milk, and has a powerful effect in increasing the quantity of it, or in keeping it at a maximum. A general law in animal physiology stimulates increased secretion of a fluid which is frequently withdrawn; and this law has full operation in the instance of cows' milk. Yet frequent milking must be accompanied by an ample supply of the food out of which the elements of milk are formed, else all increase in stimulating action will be a sheer wasteful expenditure of strength. Every milking ought to occur at a precisely regular interval from the preceding; for if later than that interval, it will allow the udder to be gorged, and to throw back a portion of its contents into the cow's system by absorption; and if earlier than the interval, it will occasion the udder to have too small capacity for the milk which would naturally be secreted during the longer interval that is to follow. Every drop of milk, also, ought to be drawn off at each milking; for when any portion is allowed to remain, it seems to be absorbed back into the system, or to serve as an indication to the secretory vessels to secrete a proportionally less quantity during the following interval; so that the quantity of produce at a milking after any portion of milk has been left in the udder is likely to be very perceptibly below the average. But a sufficient frequency of milking is thrice-a-day during the cows' fullest period of milk, and twice-a-day during all other times of the year.—*Boussingault's Rural Economy*.—*Aiton's Dairy Husbandry*.—*Paper by Mr. Harley of Willowbank in Quarterly Journal of Agriculture*.—*Curwin's Economy of Feeding Stock*.—*Journal of the Royal*

Agricultural Society.—*Mortimer's Husbandry.*—*Sproule's Agriculture.*—*Arthur Young's Works.*—*Stephens.*—*Lowce.*—*Rham.*

COWA. See MANGOSTEEN.

COWANIA. A genus of very beautiful evergreen shrubs, of the rosaceous tribe. The plaited-leaved species, *C. plicata*, was introduced to Britain about ten years ago, from the uplands of Mexico; and is one of the most elegant accessions to our gardens and to the foregrounds of our shrubs made during the period of modern botanical research. Its stem is decumbent, much branched, about two feet high, and covered with a dark brown bark; its branches are profusely clothed with stalked glands, and are scaly below from the remains of fallen leaves; its leaves are cuneately oblong, pinnatifid, plaited, half an inch or upwards in length, dark green, shining, and minutely glandular above, and white and downy beneath; its leaflets vary from five to seven on each leaf, and are obtuse and short, and have revolute and occasionally toothed margins; and its flowers are terminal, solitary, and pedunculate,—the buds exactly like those of the rose,—the calyx turbinate, hollow, pubescent, and five-segmented,—the petals five, obovate, double the length of the calycine segments, and richly lilac in colour,—and the stamens seventy-two, yellow-anthered, and disposed in many series.—Another species, differing from *C. plicata* in having tripartite leaves with entire leaflets, has also been introduced. The genus is intermediate between *Dryas* and *Purshia*; and is easily distinguishable from them by well-marked botanical characters.

COWBANE, or **WATER HEMLOCK**,—botanically *Cicuta*. A genus of hardy, herbaceous, perennial-rooted plants, of the umbelliferous order. The poisonous species, *Cicuta virosa*, grows wild in ditches, still margins of rivers, small ponds, and other standing waters in Britain. But it is not very common. Its root is tubercous and hollow; its stem is furrowed, leafy, hollow, branched, and usually between 3 and 4 feet high; its leaves are winged, bright-green, and tapering; its umbels are large; its flowers are whitish-yellow, and appear in July; and its seeds are channelled and resemble those of parsley. This plant is sometimes in its young state eaten by cattle; and it acts upon them as a violent poison, and hence acquires its popular name of cowbane. Any of it which is known to exist or can be discovered within reach of the cattle of a farm ought to be extirpated. It has not unfrequently been used medicinally as a substitute for hemlock, but rather from ignorance, than from enlightened design.—The spotted species, *Cicuta maculata*, is a native of North America, and was introduced to Britain in 1759. It has a height of about 20 inches, carries whitish-coloured flowers in July and August, and is exceedingly poisonous. Two other exotic species are known, and have been introduced.

COWBERRY, — botanically *Vaccinium Vitis Idaea*. A small, evergreen, fruiting undershrub, of

the whortleberry genus. It grows wild in mountainous woods, and in dry, stony, turfy heaths in many parts of Scotland, Wales, and the north of England, but is particularly abundant in the Scottish Highlands. Its roots are creeping; its stems are erect, and from 3 to 10 or 12 inches high; its branches are few, irregular, leafy, and downy, and occur only at the top of the stem; its leaves are obovate, revolute, dark green and shining above, and pale and glandularly dotted below, and are frequently mistaken for those of *Arctostaphylos Uva Ursi*; its flowers are produced in drooping, terminal clusters, and have a pinkish flesh colour, and appear from April till June; and its berries are deep red, roundish, astringent, and bitterly acidulous,—but they greatly improve in flavour and sapidity by steeping in water, and they are extensively used for tarts, for condiments, and for the healing of soreness in the throat. Two varieties of this plant, *V. v. major*, and *V. v. maxima*, have been introduced from North America; and both these and the indigenous variety are propagable from suckers in a peaty soil, but evince great dislike to cultivation. See the article WHORTLEBERRY.

COW-CABBAGE. See CABBAGE.

COWDIE PINE. See DAMMAR PINE.

COW-DUNG. See FARM-YARD MANURE.

COW-GRASS. See CLOVER.

COW-HERB. See SOAPWORT.

COW-HERD. See HERDSMAN and FARM-SERVANTS.

COW-HOCKED. See MALLENDERS.

COW-HOUSE. The building or apartment in which milch-cows are kept. This, in Scotland, is commonly called a byre. It ought to be well-ventilated, comfortably warm, thoroughly dry, and kept in a clean and tidy condition. Two windows, in even a large cow-house, are sufficient for light; and, if properly constructed, they may, jointly with a door of upper and lower halves, be sufficient also for ordinary ventilation; yet the ceiling ought to be open quite up to the slates, and an express ventilator is often of much service in regulating the temperature and pouring in desirable supplies of fresh air. The width of a cow-house with one row of stalls ought to be 18 feet, or 2 feet for the manger, 8 for the cows, 1 for the urine-sewer, and 7 for a passage, for the milking-pails, and for calf-pens. Each cow ought, for the sake of peace and quietness, to have a stall to herself; and each stall, in order to allow free room for lying down and rising, ought to be 5 or 5½ feet wide. The partitions between the stalls may be only 3 feet high, and need not extend farther than to the flanks of the cows or about 6 feet from the wall. The mangers ought to stand on a basis of about 18 or 20 inches above the level of the floor; and when cows are fed on steamed food or mashea, the mangers ought to be moveable in order that they may be frequently scoured. A good mode of securing cows in the stalls, or of attaching them to the stakes, is no-

ticed in the article *BAIRIE*. The urine-sewer ought to be flagged in the form of a long and comparatively narrow trough; and the rest of the floor may either be causewayed, or otherwise so formed as to be firm, dry, and resistive. Other features of the cow-house are the same as those of the stalled ox-house. See the articles *OX-STALLS* and *FARM-BUILDINGS*.

Mr. Harley's byre of Willowbank at Glasgow was long regarded, not only as one of "the sights" of the commercial metropolis of Scotland, but as the best-appointed cow-house in Britain; and therefore deserves to be briefly noticed. It contained, under one roof, stalls for ninety-six cows, placed in double rows across the building, two rows facing each other, with an intermediate passage from which the cows of both rows were fed. The floors reclined toward the centre, so as to discharge all liquid upon them into a central or common drain, which communicated with a common reservoir; and they daily underwent a thorough cleansing. The temperature was completely commanded by an apparatus of ventilation, and was maintained, as nearly as possible, at about 60° Fahrenheit. The divisions between the stalls consisted of grooved pillars of cast-iron, and intermediate boards fixed into the grooves of the pillars; and each cow was bound to an iron rod or slider, by means of a slight iron chain round her own neck, and a sliding ring upon the slider; and when she was fed with potatoes, a pin was so inserted in the attachment as to prevent her from so far raising her head as to incur the risk of being choked.

COWITCH,—botanically *Mucuna*. A genus of curious, evergreen, tropical climbing plants, of the kidney-bean division of the leguminous order. About twenty species are known to botanists; and twelve of these have been introduced to the hothouses of Britain. Two of the introduced species, *M. gigantea* and *M. altissima*, attain a height of respectively about 20 and about 50 feet; and all the others have usually a height of about 10 or 12 feet. The leaves of all resemble those of kidney-beans; the flowers of *M. urens* are yellow, of *M. nivea* are white, of *M. gigantea* are green, and of most of the others are purple; and the pods of *M. monosperma* are one-seeded, of the others are variously from two-seeded to six-seeded, and of most are exceedingly wrinkled, furrowed, scaly, or lamellose. A dense pubescence of short, hard, brittle, and excessively stinging hairs covers the ripe pods of most of the species; it readily breaks off, sharply pierces the skin, and causes a powerfully irritating pain as of an intense and intolerable itch; and this pubescence gives excessive annoyance to domestic animals in the tropics, and hence derives its popular name of cowitch. The several species climb among hedges, among shady thickets, and among jungles by the sides of rivers; and therefore are in the very situation to fling their pubescence upon animals in quest of shade or drink

during the heat of the day. The pubescence, or cowitch proper, is particularly abundant on the pods of *M. pruriens*, *M. urens*, and *M. monosperma*; the first of which was introduced to Britain from India in 1680, the second from the West Indies in 1691, and the third from India in 1816. It has several very powerful medicinal properties, and is used in tropical America as an anthelmintic, and in India in violent diarrhoea; but though imported to Britain and often to be found in our drug-shops, it seems to be far oftener used with us for purposes of mischief and torment than for any useful purposes. White says, "It is a powerful anthelmintic in the human subject, and would probably be found very serviceable in the horse; but I believe it has never been tried." When given as a medicine, it is usually administered in honey or treacle. The pubescence of the caterpillar of the procession moth, *Lasiocampa processionea*, so common in gardens, is supposed to be very similar to it in manner and power of medicinal action. The pods of the several species of *Mucuna*, while in an unripe state or before the pubescence hardens, are used as food in the same manner as other esculent legumes. *M. urens* was formerly assigned to the genus *Dolichos*; and five or six of the species are sometimes designated by some other generic name than *Mucuna*.

COW-PARSNIP,—botanically *Heracleum*. A genus of hardy, herbaceous plants, of the umbelliferous order. The common species, *Heracleum sphondylium*, grows wild in hedges, by the side of brooks and ditches, and in moist meadows, in many parts of Britain. Its root is whitish, sweetish, aromatic, and somewhat mucilaginous, has a fleshy consistency and a fusiform or carrot shape, and strikes deep into the ground; its stem is hollow, furrowed, branchy, and usually from 4 to 6 feet high; its lower leaves are produced from large membranes or sheaths, and stand on very hairy footstalks,—they are rough to the touch, a deep green above, and pale below,—and each consists of three pairs of large pinnate wings, placed along its midrib, while each of the wings consists of two or three pairs of pinnae and a terminating odd one; the upper leaves are produced singly at each joint of the stem, and are of the same shape as the lower leaves, but smaller and sessile; its flowers have either a white or a reddish colour, and appear in May and June, and are produced in large umbels at the top of the stems,—each umbel composed of about 22 partial umbels, every third having longer footstalks than the others; and its seeds are flat, bordered, brown, and abundant. The whole plant is good, nourishing food for cattle; and is extensively used in Sussex for fattening hogs. Other popular names of it than cow-parsnip, are hogweed, madrep, wild parsnip, and meadow parsnip.

The narrow-leaved species, *Heracleum angustifolium*, grows wild in waste places in some parts of Britain, and has a very similar height, appear-

ance, and character, to the common species.—The cow-paralei species, *H. panaces*, is a perennial, and a native of Siberia, and was brought to Britain before the close of the 16th century; but, in spite of its somewhat promising name, it possesses little interest.—The gum-bearing species, *H. gummiferum*, is a biennial, of somewhat medicinal pretensions, and was brought to Britain in 1819.—About a quarter of a hundred of other species have been introduced, and six or seven more have been scientifically described; but, except for some of them having a handsome appearance, they challenge the attention of no one but the systematic botanist.

COW-POX. A well-known pustular disease of the teats of the cow. It has been proved to be identical in physiological character with the small-pox of the human subject; and it furnishes the means—the purulent matter of vaccination—by which the deadly power of that disease over the human race has in modern times been broken.

But another and far milder pustular disease often attacks the teats of the cow, and has very often been confounded with cow-pox—indeed, previous to the discovery of the remedial energy of vaccination, was always confounded with it—but ought to be carefully distinguished. The pustules of this are neither so large, so round, nor so deep as those of cow-pox, nor have they the latter's bluish colour; they appear like small vesicles, but often greatly vary in both size and form; they are filled, from the first, with purulent matter; if rubbed off, they leave sore ulcers, which are sometimes not very easily healed; and if not molested, they soon form a scab, throw it off, and are sound. These pustules are not contagious; and they may, in any instance, be readily cured by proper washing and fomenting, or by the application of an ointment of lard, wax, alum, and sugar of lead, suitable for ordinary soreness of teats.

The pustules of cow-pox have a bluish colour, a roundish form, and a little central depression; they are filled, at first, with a thin, limpid, virulent fluid, and they afterwards and gradually become opaque and purulent; each is surrounded by a broad circle of inflammation; they are easily broken in milking; and when either broken, neglected, or roughly handled, they leave ulcers which are very foul and usually difficult to heal. These pustules, unlike the former sort, are evidently the eruption of a morbid virus in the blood, and, though local in manifestation, are strictly constitutional in character. At the time, or a little before the time of their appearing, the cow droops, refuses to feed, ceases to ruminate, is dull and heavy in the eyes, labours under considerable fever, and almost ceases to give any milk. She should not be bled, but ought to be freely purged, to receive a fever drink once or twice a-day, and to have her teats washed evening and morning with a lotion of Goulard's ex-

tract and camphorated spirit of wine, or with a diluted solution of the chloride of lime; and if the ulcers become very bad and obstinate, they may be treated in the same manner as garget. See the article GARGET.

The pustules of cow-pox are exceedingly contagious, and have been known, from time immemorial, to communicate cow-pox to persons who handle the teats of cows. A person infected from the teats has the pustules about the ends and joints of his fingers, and, if he have rubbed his face with his hands, he has them also on his cheek and lips; he becomes feverish, shivers, vomits, and is restless and excited; he suffers pain in the head and limbs; and in three or four days, his pustules burst, leaving ulcers which, in some instances, are foul and refractory. Persons thus affected were very long ago known to multitudes of farmers both in Europe and in America, to be generally invulnerable to the attacks of small-pox; and hence the suggestion of the modern and most benign practice of vaccination. One inoculation was, for a time, believed to afford protection for life; but experience has proved that a second or even a third inoculation may, in some instances, be necessary. The principle on which vaccination operates is explained as follows by Liebig:—

“The effects of vaccine matter indicate that an accidental constituent of the blood is destroyed by a peculiar process of decomposition, which does not affect the other constituents of the circulating fluid. If the manner in which the yeast of Bavarian beer acts be called to mind, the *modus operandi* of vaccine lymph can scarcely be matter of doubt. Both the kind of yeast here referred to and the ordinary ferment are formed from gluten, just as the vaccine virus and the matter of small-pox are produced from the blood. Ordinary yeast and the virus of human small-pox, however, effect a violent tumultuous transformation, the former in vegetable juices, the latter in blood, in both of which fluids respectively their constituents are contained, and they are reproduced from these fluids with all their characteristic properties. The precipitated yeast of Bavarian beer, on the other hand, acts entirely upon the sugar of the fermenting liquid, and occasions a very protracted decomposition of it, in which the gluten which is also present takes no part. But the air exercises an influence upon the latter substance, and causes it to assume a new form and nature, in consequence of which this kind of yeast also is reproduced. The action of the virus of cow-pox is analogous to that of the low yeast; it communicates its own state of decomposition to a matter in the blood, and from a second matter is itself regenerated, but by a totally different mode of decomposition; the product possesses the mild form, and all the properties of the lymph of cow-pox. The susceptibility of infection by the virus of human small-pox, must cease after vaccination.

for the substance to the presence of which this susceptibility is owing has been removed from the body by a peculiar process of decomposition artificially excited. But this substance may be again generated in the same individual, so that he may again become liable to contagion; and a second or a third vaccination will again remove the peculiar substance from the system."

COWSLIP,—botanically *Primula veris*. A low, perennial, herbaceous, beautifully-flowering plant, of the primrose genus. It grows naturally in the meadows and moist pastures of Great Britain; and is one of the most handsome and loved of the wild plants of our country. It is strictly similar to the common primrose in root, leaf, and form of flower, but differs and is readily distinguishable from it by its flowers being produced in bunches at the top of the footstalk. It is generally regarded as quite a distinct species from both the primrose and the oxlip,—*Primula vulgaris* and *Primula elatior*; but all the three, together with several intermediate varieties, have been repeatedly obtained from the seed of a single plant; and as to the innumerable and very beautiful varieties and subvarieties, single, semi-double, and double, endlessly diversified and variegated in the tints of their petals, and in some instances coloured in their calyxes—as to these, which adorn every garden under the popular and comprehensive name of polyanthus, and which have every shade and character of colour, from the simple yellow of the plain wild primrose, up to the most elaborate rivalry with the finest and most gorgeous auriculas, we cannot possibly regard them otherwise than as the mingled offspring of the primrose, the oxlip, and the cowslip,—following in some instances the exact type of the primrose, and in others the exact type of the cowslip, but aggregately so blended as to be really a congregation of undistinguishable hybrids.

The common wild cowslip is yellow in its flowers, and much rarer in occurrence than the wild primrose; and it blooms in May and June. It abounds most on clayey and chalky soils. Its old names were paigle and paralysis; and its reputed virtues, for both economical and medicinal purposes, were numerous. Its flowers have a fine odour, and are used to impart fragrance to preparations called cowslip wine and balsamic tea; and its roots have an agreeable perfume, of a carminative and gently aromatic character, and are used for improving the flavour of malt liquors. The leaves are sometimes used in the kitchen; and both they and the flowers are greedily eaten by cattle. The chief of the medicinal powers anciently ascribed to the cowslip was that of an anodyne; but this is either a sheer fancy, or exists only in the pleasant look and odour of the flowers.

COWSLIP (AMERICAN). See **AMERICAN COWSLIP**.

COW-TREE,—botanically *Galactodendron*. An

evergreen, tropical, and remarkably economical tree, of the nettle tribe. It constitutes a genus of itself, and takes for its specific name *utile* or the useful; but it is very closely allied to the genus *brosimum*. It grows wild on the rocky declivities of the northern Andes; and was introduced, in 1829, from the Caraccas to Great Britain. Its roots are thick and ligneous, and scarcely enter the crevices of the rock on which they grow; its stem usually attains a height of about 50 or 60 feet, but is sometimes 7 feet in diameter and considerably upwards of 100 feet in altitude; its branches have, during several months of the year, an appearance as if dry and dead; and its leaves are fan-shaped, and, in spite of long droughts in every year, are strictly perennial. When an incision is made in the trunk, particularly about the time of sunrise, a fluid is copiously discharged which has all the appearance and many of the properties of milk, and which the natives eagerly collect in vessels to be used in the same manner in which cows' milk is used in Europe. This fluid, when received into vessels, becomes yellow, and thickens at the surface; it is not so thin as the milk of animals, yet mixes easily with water; and when boiled, it forms a thick pellicle on the surface, but does not, even with the aid of acid, form any coagulum. "The milk obtained by incisions made in the trunk," says Humboldt, "is glutinous, tolerably thick, free from all acrimony, and of an agreeable and balmy smell. It was offered to us in the shell of the trituros or calabash tree. We drank a considerable quantity of it in the evening, and very early in the morning, without experiencing the slightest injurious effect. The viscosity of the milk alone renders it somewhat disagreeable. The negroes and free labourers drink it, dipping into it their maize or cassava bread." Mr. Lockhart, of the Trinidad Botanic Garden, bears a similar testimony, compares its taste and consistency to those of sweet cream, and says it is used by the inhabitants wherever it is known. M. Boussingault examined the milk fresh from the tree, and made analyses of it on the spot; and he says: "By the mere action of heat, it is separated into two distinct portions,—the one fusible, of a fatty nature,—the other fibrinous, and presenting all the characters of animal substances. If the evaporation of vegetable milk is not carried too far, the fatty matter may be obtained unchanged; it then possesses the following properties:—it is white, translucent, sufficiently solid to resist the impression of the finger; it fuses at 140° Fahrenheit; boiling alcohol dissolves it completely; it is equally soluble in potash. The fibrinous matter presents all the characters of fibrine, obtained from the blood of animals; for this reason we have called it fibrine. In fact, when put on a hot iron, it swells up, fuses, and becomes carbonized, exhaling the odour of grilled meat. Treated with weak nitric acid, it gives out nitrogen gas; by

distillation, it disengages ammoniacal vapours in abundance." He then states that the fatty matter is analogous to bees' wax, so that a kind of wax candles can be made of it; and adds that the liquid which remains after the fatty and the fibrinous matters are separated, is water holding in solution a free acid, a little sugar, and some saline substances,—and, that, on burning the milk, ashes were obtained consisting of phosphate of lime, lime, magnesia, and silica. An attempt was commenced, about 20 years ago, to propagate and cultivate the cow-tree in the West Indies.

COW-WHEAT,—botanically *Melampyrum*. A genus of annual weedy plants, of the figwort tribe. Their botanical name signifies 'black wheat,' and alludes to the black and wheat-like appearance of their seeds; and their popular name implies that these seeds might probably be cultivated as food for cattle, or alludes to the fact that cows and oxen greedily eat the entire plant. Four species are indigenous as weeds in Britain; and a fifth species, of a sort of ornamental character, was long ago introduced from continental Europe. All are about 20 inches high, and bloom in July, and have yellow-coloured, tubulous, four-segmented flowers. The broad-leaved or common meadow species has the floral footstalks standing at a distance; and it grows wild in the woods of many parts of Britain. The narrow-leaved species has quadrangular spikes, and grows plentifully in Bedfordshire and Cambridgeshire. The species with blue tops occurs sparsely in some of the sandy lands of Norfolk, and is an abundant corn-weed in Flanders and West Friesland. This last species has been accused of damaging bread and producing deleterious effects in the same manner as darnel; yet is said to be delicious food for cattle, and was formerly proposed for cultivation as fodder.

CRAB. This name—which appears to be derived from the Latin *carabus*, used by Pliny to designate certain crustaceous species—is now applied to a considerable group of invertebral animals, whose bodies are covered by an external skeleton, or calcareous crust, having ten articulated limbs, adapted for swimming or walking, and breathing by branchiæ or gills. The head and corselet are united, the latter being broader than it is long. The tail is short in proportion, and concealed by being turned forward beneath the body. This genus is distinguished from all others of the same family by the semicircular shape of the corselet, the pointed or hooked extremities of the last joint of the limbs, the narrowness of the superior shell from before backwards, the posterior direction of the hinder tarsi, and the absence of spines or ridges from the forceps, or biting claws. They belong to the fourth section of ten-legged, short-tailed crustacea, *Decapoda brachyura*, of the latest systems, and are of numerous species, exceedingly various in size, colour, and modes of living. A slight survey of

the structure of these animals might lead to the opinion that their senses were limited or imperfect; but proper observation shows the contrary to be true. The sense of sight, in most of the species, is peculiarly acute, and enables them to distinguish the approach of objects from a very considerable distance. Their power of smelling is also great, though we have not yet discovered the organ by which this sense operates. It has been inferred that the antennæ serve this purpose. Until more positive knowledge is acquired on the subject, no evil can arise from this opinion as to the seat of the sense of smell. The entrance to the organ of hearing is at the base of the peduncle sustaining the antennæ, and consists of a small, hard, triangular prominence, covered by a membrane, within which is a cavity containing the expanded auditory nerve. Of all the senses, that of touch, except so far as it may be possessed by the antennæ, appears to be the least perfect, since the whole body and limbs are incrustated with a hard, compact shell. Of the sense of taste, we can say nothing, but that, as the animals possess a remarkably complex and elaborate apparatus for mastication, there is no reason for believing them devoid of this sense. The mouth is furnished with at least eight pieces or pairs of jaws, which pass the food through an extremely short gullet into a membranous stomach of considerable size. This stomach is rendered curious by having within certain cartilaginous appendages, to which strong grinding teeth are attached. These, in crabs, are five in number, and placed at the pyloric extremity, or outlet of the stomach; so that the aliment, after being subjected to the action of the jaws, is again more perfectly chewed by the stomach-teeth, before entering the digestive tube, where it is exposed to the action of the biliary fluid of the liver. The latter organ is of great size in these creatures, and is all that soft, rich, yellow substance, found immediately beneath the superior shell, usually called the fat of the crab, and justly esteemed a delicious morsel. A little posterior to the stomach (commonly called sandbag), the heart is situated—a somewhat globular, whitish body, which propels a colourless lymph to the gills and rest of the body, whence it is brought back to the heart by a hollow vein of considerable size. The process of sloughing, moulting, or throwing off the entire calcareous covering, which constitutes their only skeleton, is common to all the crustacea, and is very worthy of attention.

CRAB-TREE. See **APPLE-TREE** and **VERJUICE**.

CRACCA. See **VETCH**.

CRACKS. Soreness in the heels of horses. Ordinary forms of it are often occasioned by want of care and of cleanliness; and a virulent form of it sometimes attends grease. See the article **GREASE**.

CRADLE. A wooden necklace for a horse. It consists of a string of round pieces of wood; and

is so hung upon a horse as to restrain him from interfering with the medicinal application of a blister.

CRADLE. A sort of bow or rake attached to the heel of the blade of a reaping scythe, to assist in gathering the corn into regular swerths. The construction of cradle-scythes is very various. See the article **SCYTHE**.

CRAIG. A rocky precipice; also, in Suffolk, calcareous sand or gravel, largely consisting of comminuted or broken sea-shells, and serving as an excellent manure on cold, wet, or clayey land.

CRAMBE. See **SEA-KALE**.

CRAMP. A sudden and severe spasm, akin to tetanus, but of much shorter duration. It attacks principally the hinder extremities of the horse; and occurs, for the most part, after the animal has been hard worked, and just when he is led out of the stable. A horse attacked by it ought, in order to be preserved from a repetition of it, to be exceedingly well groomed, and to have the affected limb rubbed hard with the hand; and if he have stood in a confined stall, he should be removed to a stall of greater capacity.

CRANBERRY. A small red fruit, produced by four species of small, hardy, wiry, evergreen undershrubs, of the heath family. These species are four in number, and formerly belonged to the whortleberry genus, but now constitute a genus of themselves, under the name of *Oxycoccus*,—a word which signifies "acid-fruit," and alludes to the sharp taste of the berry. The marsh species, *Oxycoccus palustris*, formerly called *Vaccinium oxycoccus*, grows in peaty bogs and marshy grounds in Russia, Sweden, the north of England, and Germany, and in North America. The leaves are small, somewhat oval, and rolled back at the edges, and the stem is thread-shaped and trailing. The blossoms are small, but beautiful, each consisting of four distinct petals, rolled back to the base, and of a deep flesh-colour. The American cranberry, *O. macrocarpus*, growing in bogs principally, on sandy soils, and on high lands, frequent from Canada to Virginia, is a larger and more upright plant than the last, with less convex, more oblong, much larger leaves. The berries are larger, of a brighter red, and collected in great abundance for making tarts, jelly, &c. They are also exported to Europe, but are not considered equal to the Russian cranberries. These fruits are collected in America by means of a rake; in Germany, by wooden combs. In Scotland and England they are picked by hand, as they grow with us but scantily. They are preserved with sugar, much of which is required to correct the natural tartness of the berries. They may be preserved dry in bottles, corked so closely as to exclude the external air: some persons, however, fill up the bottles with spring water. They keep very long in fresh and pure water. At sea, they are an agreeable addition to the few articles of diet which can be had. The other two species of cranberry are the red-fruited and the hispid,

both rather recently introduced to Britain, the former from the United States of America, and the latter from Hudson's Bay. The hispid is about the same size of plant as our indigenous species; but the red-fruited is 6 or 7 times larger.

CRANE. A genus of birds belonging to the order *Grallæ*, L.; and, by the great Swedish naturalist, comprised in his extensive genus *Ardea*, though properly ranked as a distinct genus by all subsequent naturalists. The distinctive characters of this genus are as follows:—The bill is but little cleft, is compressed, attenuated towards the point, and rather obtuse at its extremity; the mandibles are subequal, with vertical margins, the upper being convex, with a wide furrow on each side at the base, which becomes obliterated before reaching the middle of the bill. The nostrils are situated in these furrows, and are medial-concave, elliptical, pervious, and closed posteriorly by a membrane. The tongue is fleshy, broad, and acute. The ophthalmic region and lora are feathered, though the head is generally bald, rough, and sometimes crested. The body is cylindrical, having long and stout feet. The naked space above the tarsus is extensive, and the latter is more than twice as long as the middle toe. The toes are of moderate length, covered with *scutellæ*, or small plates, and submargined; a rudimental membrane connects the outer one at base; the inner is free; the hind toe is shorter than a joint of the middle one, and is articulated with the tarsus, elevated from the ground; the nails are tile-shaped, faculate, and obtuse; the middle one has its cutting edge entire; the hind nail is the longest; the wings are moderate, with the first and fifth primaries subequal; the tail is short, and consists of twelve feathers. These birds are generally of considerable size, and remarkable for their long necks and stilt-like legs, which eminently fit them for living in marshes and situations subject to inundations, where they usually seek their food. This is principally of vegetable matter, consisting of the seeds of various plants, or grains plundered from grounds recently ploughed and sown. They also devour insects, worms, frogs, lizards, reptiles, small fish, and the spawn of various aquatic animals. They build their nests among bushes, or upon tussocks in the marshes, constructing them of rushes, reeds, &c., surmounted by some soft material, so high that they may cover the eggs in a standing position. They lay but two eggs, for whose incubation the male and female alternately take their place on the nest. During the time that one is thus engaged, the other acts as a vigilant sentinel; and, when the young are hatched, both parents unite in protecting them. The cranes annually migrate to distant regions, and perform voyages astonishing for their great length and hazardous character. They are remarkable for making numerous circles and evolutions in the air, when setting out on their journeys, and generally form an isosceles triangle, led by one of

the strongest of their number, whose trumpet-like voice is heard as if directing their advance, when the flock is far above the clouds, and entirely out of sight. To this call-note of the leader the flock frequently respond by a united clangour, which, heard at such a distance, does not produce an unpleasing effect. From the sagacity with which these birds vary their flight, according to the states of the atmosphere, they have, from the earliest ages, been regarded as indicators of events; and their manœuvres were attentively watched by the augurs and aruspices—a circumstance which, together with their general harmlessness and apparent gravity of demeanour, led to their being held in a sort of veneration, even by some civilized nations. When obliged to take wing from the ground, cranes rise with considerable difficulty, striking quickly with their wings, and trailing their feet along and near the ground, until they have gained a sufficient elevation to commence wheeling in circles, which grow wider and wider, until they have soared to the highest regions of the air. When their flight is high and silent, it is regarded as an indication of continued fine weather; they fly low and are noisy in cloudy, wet, or stormy weather.

CRANE'S-BILL. See GERANIUM.

CRANK. An iron axis with the end bent like an elbow, for the purpose of moving a piston, the saw in a sawmill, &c., causing it to rise and fall at every turn; also for turning a grindstone, &c. The common crank affords one of the simplest and most useful methods for changing circular into alternate motion, and *vice versa*. Double and triple cranks are likewise of the greatest use for transmitting circular motion to a distance. In fact, cranks belong to those few simple elements on which the most complicated machines rest, and which, like the lever, are constantly employed.

CRANIUM. See SKULL.

CRASSULA. A genus of ornamental, greenhouse plants, forming the type of the natural order Crassulaceæ. This order consists of succulent plants, some herbaceous, others shrubby, some annual, others perennial, and all fleshy in their leaves and comparatively dry and arid in the character of their favourite situations. Some plants of the order may be found wild in almost every part of the world; but most occur in hot, dry, and exposed spots of the somewhat temperate portions of the eastern hemisphere, and many are at once abundant, conspicuous, and most ornamental on the sterile, arenaceous plains of the Cape of Good Hope, and on the hot cliffs and volcanic wastes of the Canary Islands. Their flowers are, for the most part, red, orange, white, or yellow, and are arranged in either corymbs, cymes, spikes, or panicles, and, in very numerous instances, are eminently beautiful. The order comprises, within the gardens and open-grounds of Great Britain, 8 or 9 hothouse species, about 180 greenhouse species, and about 90 hardy her-

baceous species; and these are distributed among 22 genera,—the most familiar of which are *crassula* in the greenhouse, and *sedum* and *sempervivum* in the open air. The hardy kinds, such as the sedums and sempervivums, grow on walls, rockwork, and other dry situations; and the tender kinds require to be potted in dry rubbish, and to receive little water except during the period of full activity.

Seven or eight species which were formerly comprised in the genus *crassula* are now assigned to other genera; but about 85 described species are still ranked as *crassulæ*, and upwards of 50 of these have been introduced to the greenhouses of Britain. Most of the introduced species have such thick, fleshy leaves and stems, as at once to evince, to even the unpractised eye, their close affinity to our houseleeks and sedums; yet they possess a certain delicacy which renders a comparison of them with houseleeks exceedingly vulgarizing, and they display in the texture and tinting of their flowers such exquisite characters as render all of them ornamental, and some of them superb. Most are from the Cape of Good Hope; about three-fourths are evergreen, undershrubs; about a dozen are annuals; and all the perennial kinds are propagated from cuttings, and the annual kinds from seeds. Among the most handsome are *C. ramosa*, *C. imbricata*, *C. acutifolia*, *C. odoratissima*, *C. tetragonia*, *C. arborescens*, *C. lactea*, *C. scabra*, *C. marginalis*, *C. perfoliata*, and *C. ciliata*; and among the newest in vogue, are *C. coccinea*, *C. versicolor*, and *C. nitida*.

CRATÆGUS. See HAWTHORN.

CRAWFISH. A crustaceous genus, belonging to the family *Decapoda macroura* (ten-legged, long-tailed), characterized by having the anterior part of the elongated, semi-cylindric, superior shell produced to form a rostrum or beak; the abdomen large, slightly attenuated posteriorly, composed of six joints, forming a tail quite as long, when extended, as the body, and terminating in five broad-fringed, swimming appendages, which fold laterally upon each other. In both sexes, the under part of the abdomen is generally provided with five pairs of false claws, each terminated by two plates or plaments. The exterior jaw-feet are mostly narrow, elongated, and do not entirely cover the other parts of the mouth. The gills are pyramidal, brush-shaped, or plume-like, separated from each other by tendinous alips, and situated beneath the sides of the great superior shell, over the external base of the feet. Of the latter, the second and third pairs are elongated, slender, and furnished at the last joint, which is moveable, with small pincers; the fourth and fifth pairs have the last joints simply pointed or hooked. The sexual organs are placed, in both sexes, in the basal joint of the last pair of feet. The species belonging to this genus, as at present restricted, do not exceed six. Some of these kinds are peculiar to salt and others to fresh water. Of the former, the most celebrated

is the lobster. In their modes of living, the crawfish generally resemble the aquatic crabs, feeding on putrefying animal matter, spending their time on the sandy or rocky bottom of deep waters, and only approaching the shallows when impelled by the necessity of undergoing their change of shell, or when under the sexual influence. The common lobster is the largest species, and grows to a size which may well appear wonderful to persons accustomed to see none but small ones. They are brought to the New York market more than two feet in length, and weighing 20 pounds and upwards. Such individuals, however, are not preferred for the table, as their size is a good indication of their age, and their period of life is stated to extend to twenty years and more. The smaller, or half-sized lobsters, are considered the best.

CREAM. See BUTTER.

CREAM-CHEESE. See CHEESE.

CREAM-GAUGE. A graduated cylindrical glass for ascertaining the proportion of cream which exists in specimens of milk. If the glass be ten inches deep, and properly graduated, every tenth of an inch on the scale will indicate one per cent. of cream. The specimen of milk to be gauged is filled into the glass immediately on being drawn from the cow; and the glass is placed at rest with it during a given number of hours. The chief use of the instrument is, not to exhibit the per-centage of cream in individual specimens of milk, but to detect fluctuations in the proportion of cream from one cow or one set of cows. These fluctuations are sometimes both sudden and considerable; and when they are promptly detected by the dairyman, the causes of them may, in many instances, be investigated, discovered, and removed. See the articles Cow, MILK, and DAIRY.

CREAM OF TARTAR, or supertartrate of potash. A salt which exists in grapes and in tamarinds. The dregs of wine also contain a considerable quantity of it. Cream of tartar contains a very considerable proportion of supertartrate of potash, about seven or eight hundredths of tartrate of lime, and a small quantity of silica, albumen, iron, &c. It is insoluble in alcohol, but may be dissolved in 15 parts of boiling and 60 of cold water. It may be rendered much more soluble by mixing with it a certain quantity of boracic acid or borate of soda, which renders the cream of tartar soluble in its own weight of cold water, and in the half only of this menstruum when boiling. This preparation is known by the name of *soluble cream of tartar*. Its aqueous solution is soon decomposed by the contact of the air. It is obtained by dissolving in boiling water the common tartar—a white or reddish crystalline matter, which forms on the internal sides of the vessels in which wine has been kept—mixing with it some clay, which precipitates the colouring matter, and then permitting the liquor to crystallize. The action of this substance varies according to

the dose in which it is administered. In small doses, it is absorbed, and acts as a temperant; and, in this quality, it is employed in jaundice, foulness of the stomach and intestines, &c. In larger doses, it principally spends its action on the mucous intestinal membrane, and induces alvine evacuations, especially when given in powder. Its taste being rather less unpleasant than that of some other neutral salts used in medicine, and its operation being of a very gentle nature, it is very frequently administered. In France, the soluble cream of tartar is generally preferred.

CREASOTE, or CREOSOTE. A powerfully antiseptic and medicinal liquid, obtained from crude pyroligneous acid and from the heavy portion of the oil of wood tar. It consists of 77.42 per cent. of carbon, 14.46 of oxygen, and 8.12 of hydrogen. It was discovered by Reichenbach; and has come rapidly and extensively into use for the conservation of salt meat, the flavouring of hams, the cure of tooth-ache, and various purposes in medicine. It is often popularly called essence of tar. It is colourless and transparent; it has a caustic and burning taste, and a strong, smoky, tarry odour; it is slightly heavier than water; it burns with a sooty flame; it is soluble, in all proportions, in alcohol or ether, but is insoluble in any smaller proportion of water than eighty to one; and it combines with acids, alkalies, sulphur, bromine, phosphorus, iodine and chlorine, but is decomposed by strong nitric acid or by undiluted sulphuric acid.

Creasote is the best remedy known for tooth-ache, but requires to be cautiously applied, and in no degree swallowed. It acts as a powerful caustic, and rapidly kills all small animals. It coagulates the albumen of blood, and, in consequence, is a remedy for hæmorrhage. In the several diluted forms of lotion, liniment, and ointment, it is used, in farriery, for canker, foot-rot, thrush, mange, caries, fungous growth, farcy, and glanders; and when internally administered, with judgment and care and in extreme dilution, it acts as a stimulating tonic. The antiseptic power of wood-smoke upon salt meat and dried fish consists in the evolution of creasote; and this power is obtained with great facility, though not with so agreeable a result upon the flavour of the meat and fish, by simply dipping in a weak solution of creasote and water. If a plate, containing a little creasote, be placed in a larder beneath fresh meat in summer, and a cloth be so thrown over the meat as to prevent the vapour of the creasote from being speedily dissipated, the meat will keep fresh for three or four days longer than without this expedient, and will not be infested with the attacks of flies, and, at the same time, will not contract any of the creasote's peculiar smell.

CREDIT. The postponement agreed on by the parties of the payment of a debt to a future day. It implies confidence of the creditor in the debtor; and a *credit system* is one of general con-

fidence of people in each other's honesty, solvency and resources. Credit is not confined to civilized countries; Mr. Park mentions instances of it among the Africans; but it will not prevail extensively where the laws do not protect property, and enforce the fulfilment of promises. Public credit is founded upon a confidence in the resources, good faith, and stability of the government; and it does not always flourish or decline at the same time and rate as private credit; for the people may have either greater or less confidence in the government than in each other: still there is some sympathy and correspondence between the two; for a general individual confidence can rarely, if ever, take place in the midst of distrust of the government; and, *vice versa*, a firm reliance upon the government promotes a corresponding individual confidence among the citizens. The history of every industrious and commercial community, under a stable government, will present successive alternate periods of credit and distrust, following each other with a good deal of regularity. A general feeling of prosperity produces extension and facilities of credit. The mere opinion or imagination of a prevailing success has, of its own force, a most powerful influence in exciting the enterprise, and quickening the industry, of a community. The first requisite to industry is a stock of instruments, and of materials on which to employ them: a very busy and productive community requires a great stock of both. Now if this stock, being ever so great, were hoarded up; if the possessors would neither use, let, nor sell it, as long as it should be so withdrawn from circulation, it would have no effect upon the general activity and productiveness. This is partially the case when a general distrust and impression of decay and decline cause the possessors of the stock and materials to be scrupulous about putting them out of their hands, by sale or otherwise, to be used by others; and others, again, having no confidence in the markets, and seeing no prospect of profits, hesitate to purchase materials, or to buy or hire the implements, mills, ships, &c., of others, or to use their own in the processes of production and transportation. This state of surplusage and distrust is sure to be followed by a reduction of money prices; and every one who has a stock on hand, and whose possessions are estimated in money, is considered to be growing poorer and poorer every day. But when prices have reached their lowest point, and begin regularly to rise, everybody begins to esteem himself and others as being prosperous, and the opinion contributes powerfully to verify itself. Credit begins to expand; all the stores of the community are unlocked, and the whole of its resources is thrown open to enterprise. Every one is able readily to command a sufficiency of means for the employment of his industry; capital is easily procured, and services are readily rendered, each one relying upon the success of the others, and

their readiness to meet their engagements; and the acceleration of industry, and the extension of credit, go on until a surplus and stagnation are again produced. The affairs of every industrious and active community are always revolving in this circle, in traversing which, general credit passes through the periodical ebbs and flows. This facility and extension of credit constitutes what is commonly called *fictitious capital*. The fiction consists in many individuals being supposed to be possessed of a greater amount of clear capital than they are actually worth. The most striking instance of this fictitiousness of capital, or, in other words, excess of credit, appears in the immense amounts of negotiable paper, that some individuals and companies spread in the community, or of paper currency, where the issuing of notes for supplying currency by companies or individuals is permitted. Individuals or companies thus draw into their hands an immense capital, and it is by no means a fictitious capital when it comes into their possession, but actual money, goods, lands, &c.; but, if they are in a bad, losing business, the capital, as soon as they are intrusted with it, becomes fictitious in respect to those who trusted them with it, since they will not again realize it.

CRENIC ACID. See APOCRENIC ACID.

CREPIS. A genus of herbaceous plants, of the chicory division of the composite family. About a dozen species formerly belonging to it are now distributed among other genera; but about fifty species still belong to it, and about twenty of these may be seen in the open grounds or in the botanical collections of Britain. Most are annuals, and nearly all have yellow flowers. The fair species grows 4 or 5 feet high, and occurs in Scottish uplands; the biennial species also grows 4 or 5 feet high, and occurs in the chalky pastures of England; and the roof species grows about 20 inches high, and occurs in the pastures of both England and Scotland. These indigenous species are sometimes called bastard hawkweed.

CRESCENTIA. See CALABASH-TREE.

CRESS (AMERICAN). See AMERICAN CRESS and VIRGINIAN CRESS.

CRESS (BELLEISLE). See WINTER CRESS.

CRESS (COMMON OR GARDEN).—botanically *Lepidium Sativum*. A hardy, annual, small salad herb, of the pepperwort genus. It is the most common of our cultivated salad plants, and is held in great and general estimation, both for the surpassing ease with which it is cultivated, and for the agreeable pungency of its taste and flavour. It was introduced from Persia about the middle of the 16th century, and has long been cultivated in almost every tasteful cottage garden. It grows about 20 inches high, and has white flowers, suborbicular silicles, and parted cotyledons. It comprises three varieties, the common flat-leaved, the curled-leaved, and the broad-leaved; and the first of these is the most generally cultivated. It may be sown in succes-

sion, once a-week, once a-fortnight, or once a-month, throughout spring, summer, and autumn; and may, in consequence, be had for use during the greater part of the year; but it speedily runs to seed, so that any one crop remains but a short time in a proper state for use. It should be sown very thick, either broadcast or in drills two or three inches asunder, and should be but lightly covered with soil.

CRESS (INDIAN). See INDIAN CRESS.

CRESS (WALL). See WALL-CRESS.

CRESS (WATER). See WATER-CRESS.

CRESS (WINTER). See WINTER CRESS.

CRESS-ROCKET, — botanically *Vella*. An evergreen, ornamental, undershrub, of the cruciferous order. It constitutes a genus of itself; and is specifically called *pseudo-cytisus* or bastard laburnum. Its root is small and tapering; its stem is erect, bushy, leafy, and about two or three feet high; its leaves are entire, oval, hairy, greyish, and sessile; and its flowers have a pale yellow colour, are produced in bunches at the top of the stem, and appear in April and May. It is commonly treated as a greenhouse plant, but is quite hardy enough to occupy a permanent place in a warm border.

CRIB. A mimic shed in a cow-house for keeping calves; a little shed for sheep; a rack for holding the fodder of cattle; or a manger for holding the corn or cut straw of horses.

CRIB-BITING. A vicious and diseased habit of dyspeptic horses. It consists in suddenly seizing with the teeth either the manger or any post or gate or similar object; and is accompanied with an eructation of gas or flatus from the stomach, which popular opinion has pronounced to be a process of exactly the opposite nature, and has designated 'sucking-the-wind.' Crib-biting seems to be indirectly occasioned by want of requisite exercise, by prolonged feeding on bad hay or musty oats, or by anything else which enfeebles the stomach and produces a dyspeptic or flatulent habit; and it is, therefore, merely symptomatic, and can be effectually cured only by curing the diseased condition of the stomach which occasions it. The leanness which always characterizes crib-biting horses, is a consequence, not of their crib-biting, but of their dyspepsy. Yet the mere crib-biting wears the teeth, and produces other bad consequences, and ought to be prevented by the fastening of a somewhat tight collar-strap round the throat.

CRICKET. A genus of orthopterous or straight-winged insects, belonging to the Grylloid family, which comprises the grasshoppers, mole-crickets, crickets proper. This family, like all other orthoptera, do not undergo a complete transformation. They are hatched from eggs symmetrically stuck together by a viscous material, either upon vegetables, or placed under ground; and, from the moment of escaping from the egg, the young are sufficiently vigorous to seek their own food, which consists of organized substances. While

yet very soft, they are perfectly formed, with the exception of the rudiments of the elytra and wings. These, in some species, are never developed. As the insect grows, the skin becomes too small, and requires to be changed as often as seven or eight times, before the insect attains its full size. The crickets are distinguished from the other members of this family by their long, silken antennæ, by having but three joints to their tarsi, and by the comparative smallness of their thighs. Their bodies are short, thick-set, and soft, with the head, corselet, and abdomen immediately applied, and of equal length and breadth. The head is thick, rounded above, and nearly vertical. Between the eyes, which are widely separated and reticulated on the surface, there are two brilliant stemmata. The corselet is quadrangular, somewhat larger transversely, and rounded at the edges. The elytra, which do not completely cover the belly, are curved squarely, and are not roof-shaped, as in the locust and grasshopper. In the winged species, the wings exceed the elytra, and even abdomen, beyond which they project, in the form of a sort of bifid tail. In addition to the two flexible abdominal appendages common to both sexes, the females have a long borer or oviduct, which is a stiff, square tube, formed of two pieces, separable and free at the point, sometimes seeming to be split, and terminating by a slight enlargement.

The noise, for which all crickets are remarkable, and usually called chirping, is produced by the friction of the bases of their elytra, or wing-cases, against each other, these parts being curiously adapted to produce this sound. Both sexes have the elytra longitudinal, divided into two portions, one of which is vertical or lateral, covering the sides, and the other dorsal, covering the back. These portions, in the female, have their nervures alike, running obliquely in two directions, forming, by their intersection, numerous small meshes, which are of a rhomboidal or lozenge shape. The elytra of the females have an elevation at the base. The vertical portion in the males does not materially differ from that of the females, but in the horizontal part, the base of each elytrum is so elevated as to form a cavity beneath. The nervures are stronger, and very irregular in their course, with various inflexions, curved, spiral, &c., producing a variety of different sized and shaped meshes, generally larger than in the female: towards the extremity of the wing, particularly, there is a nearly circular space, surrounded by one nervure, and divided into two meshes by another. The friction of the nervures of the convex surface of the base of the left or undermost elytrum against those of the concave surface of the base of the right one, causes vibrations of the membranous areas of an intensity proportioned to the rapidity of the friction. In fact, the insect may be regarded as performing on a sort of violin, the base of one elytrum serving for a bow, and the cords of the

other as the strings of the instrument. The reader, who may wish to enter upon a very minute study of this and similar insects' contrivances for producing sounds, may advantageously consult De Geer (vol. iii. p. 512), and Kirby and Spence (24th letter, vol. 2, p. 375 et seq.) The chirping of the domestic cricket, *Acheta domestica*, is by many regarded as pleasant or musical, and their presence in holes is regarded as a good omen by some people. Where they are numerous, certainly, to our ears, their noise is anything but agreeable; and it requires considerable habituation to it to be able to sleep undisturbed by it. They are very harmless, taking up their abode near chimneys, fire-places, and other warm situations, whence they come out, when the inmates of the house have retired to rest, and commence their monotonous song. If a light be brought, they speedily retreat, leaping lightly to their holes, the length and peculiar structure of their long thighs especially fitting them for this mode of progression. One action which we have observed them perform with the antennæ shows the delicacy and perfection of the muscles. They move the long silken appendages, as if cleaning or polishing them, somewhat as we see birds do with their feathers. The field crickets, *A. campestris*, are as loud and noisy in the day as those above-mentioned are at night, and largely contribute to the music of the fields, so delightful to the ear of the student of nature. Both species have attracted the attention of poets, who have celebrated their simple but lively notes in verse of various degrees of excellence. Both species are equally innoxious, subsisting on small particles of organized matter, which might otherwise become troublesome from accumulation; while, from their numbers, birds and other animals of higher rank in the scale of being obtain a part of their supply of food.

CRINUM. A genus of magnificently-flowering bulbous rooted plants, of the amaryllis tribe. The common Cape species, *C. capense*, formerly called *Amaryllis longifolia*, was introduced from the Cape of Good Hope, about the middle of last century. Its external leaves are scarious; its internal leaves are long, broad, convolute at the base, thong-like, lanceolate, rough at the margin, and glaucous on both surfaces; its superior leaves are upright, very narrow, and channelled over their whole length; its scape is about two feet long, straight, and roundish or slightly compressed; its umbel has either few flowers or many; its floral footstalks are short; its perianth is white, but has the outside of the segments tinged with red; the tube is roundish furrowed, twice as short as the limb, and recurvedly funnel-shaped; the segments are elliptico-lanceolate, and have a short claw; and the filaments of the stamens are of different lengths, and are at first dependent and afterwards reflexed and ascending. This plant, besides being highly ornamental, has the recommendations of being very hardy, of pro-

fusely flowering during nearly one-half of the year, and of requiring exceedingly little care or culture. It delights in wet, and will flower in a pond; but when exposed to the rigours of winter, requires to be in a leaf-covered bed. Herbert's species, *C. Herberti*, closely resembles the Cape species in both appearance and hardiness; and four other species have the semi-tender habits of ordinary greenhouse plants; but all the remaining species which have been introduced to Britain, are either literally from the tropics or have a strictly tropical character. But very numerous hybrids have been raised between *C. capense* and some one or other of the tropical species; and all these hybrids are hardy enough to stand out of doors against the front-wall of a stove; while many are much more brilliant than even the showy and superb natural species. One of the most beautiful of the hybrids is *Crinum-scabro-Capense*; and one of the tallest is *Crinum-pedunculato-Capense*.

CRIOCERIS. A genus of coleopterous insects, constituting the type of the family Crioceridae. The name is formed from two Greek words which signify 'ram's horns,' and alludes to the cylindrical and globularly-jointed structure of the antennæ. The species popularly called the asparagus beetle, *Crioceris asparagi*, is the only one of much interest to cultivators of the soil. Its form is oblong; its length is about a quarter of an inch; its head is rather broader than the thorax; and its thorax is cylindrical, and not so broad as the elytra. The head and legs, as well as portions of other members, are a fine blue black; the antennæ are black; the upper surface of the prothorax is a fine red, with two small dorsal black spots; and the elytra are long, and have several rows of impressed spots, very diversified in colour in each individual, and differently diversified in different individuals. The eggs of the insect are of a dirty slate colour, of a long oval form, and of comparatively great size; not more than about eight or ten seem to be deposited by one female; they are affixed, by means of a black viscid secretion, to the tender stems of young asparagus plants, or to the smallest shoots of older asparagus plants; and they sometimes occur in such vast numbers as to render the plants unfit for the table. The larvæ are soon produced; but, instead of possessing any similar beauty to that of the perfect insects, they have a disgusting form, and a dirty slaty green colour, almost black; and, when disturbed, they emit a considerable quantity of thick black fluid. They appear from the end of June till September; they feed upon twig after twig of the asparagus stems; and, after having several times cast their skins, they descend to the ground, construct for themselves thick cocoons, and pass into the condition of ordinarily formed white pupæ.

Each asparagus beetle, on the average, passes about a fortnight in the condition of an egg, about a fortnight in the condition of a larva,

and about a fortnight in the conditions of pupa and imago; so that it has an entire existence of only about six or seven weeks. But the species propagates throughout a long season; and all conditions of it may be simultaneously observed on and around one asparagus plant. The perfect insect is very cunning; for the instant it is approached, it turns to the under side of the stem; and, if disturbed, it drops down and feigns death. Some asparagus beds are completely destroyed by it; and even when some pains have been taken to extirpate it, many plants, when full grown, are quite denuded by it of their foliage. As many individuals of it as possible should be found out and destroyed at the time of the asparagus being cut; and the rest or their offspring might probably be frightened away by densely shady growths of pease, or densely shady screens of pine branches. The insect certainly has a strong aversion to both shade and moisture.—Seven or eight other species of *Crioceris* occur in Britain; and some principal genera of Coleoptera are included in the *Crioceridæ* family.

CRITHMUM. See SAMPHIRE.

CROCHLES. A variety of acute rheumatism, attacking cattle which are depastured on moist or marshy soil. An animal affected by it suffers pain in the feet, particularly the fore-feet, experiences enlargement of the small joints of the limbs, becomes hide-bound, suffers such contraction and enfeeblement of the hind-quarters as to be unable to walk or even to stand, and finally lies in one posture, loses appetite, becomes all over ulcerated, and dies. The grand remedy is, as soon as the disease is observed, to remove the affected animal to dry soil and kindly pasture. See the article RHEUMATISM.

CROCUS. A genus of beautifully-flowering, low-growing, hardy, tuberous-rooted plants, of the iris order. The spring species, *C. vernus*, grows wild in Switzerland, Piedmont, the Tyrol, Carinthia, Naples, the south of Europe, and the meadows of some parts of England. "In the neighbourhood of Nottingham," remarks Howitt, "the vernal crocus covers many acres of meadow land with its bloom, gleaming at a distance like a perfect flood of lilac, rivalling whatever has been sung of the fields of Enna." The coat of its bulb is finely netted; and its flowers have no odour, and are free from hairiness in the throat. The normal plant has purple-coloured flowers, but very numerous varieties have sprung from it, which boast the rank of florists' flowers, and exhibit a great diversity of well-marked and very beautiful tintings. Loudon enumerates twenty-nine botanically named varieties with purple and lilac flowers, two with purple feathered flowers, four with spotted flowers, three with striped lilac flowers, twenty with striped grey flowers, two with white flowers, ten with striped white flowers, and five with purple flowers and a late habit.

The party-coloured species, *C. versicolor*, grows wild in the vicinity of Nice and in all the eastern

parts of Provence, and was introduced to Britain during the former half of the 17th century. It disputes pre-eminence with the preceding species as a favourite spring crocus; and has also the recommendation, though to a less extent, of comprising numerous varieties. The coat of its bulb is not circularly cut; and its flower has a sweet scent and a hairy throat. Loudon enumerates three botanically-named varieties of it with striped grey flowers, four with striped purple flowers, three with striped lilac flowers, and fourteen with striped white flowers.—About twenty other exotic spring species, besides about as many varieties, have been introduced to Britain; and most of these have either yellow, white, or party-coloured flowers; but more than one-half have been long known, and do not rival *C. vernus* and *C. versicolor* in popular favour. All the spring crocuses may be regarded as February-flowerers; but a few are constitutionally later than the rest, and most are powerfully accelerated or retarded by situation and weather.

Four autumnal species, *C. sativus*, *C. nudiflorus*, *C. serotinus*, and *C. Pallasii*,—the last with lilac-coloured flowers, and the other three with violet-coloured flowers,—occur in gardens, and, though not contemporaneous in the commencing of their bloom, may all be seen in flower toward the end of September. Two of them, *C. nudiflorus* and *C. sativus*, occur wild in England; and the latter of these is extensively cultivated in Essex and Cambridgeshire for its produce in saffron. See the article SAFFRON.

A crocus will grow almost anywhere, and, not only without culture, but in defiance of very bad treatment. Yet crocuses, in order to be in fine condition and to produce their best effect, require the exercise of both a little care and a little judgment. If planted, in lines or clumps, three inches deep, and two inches or three from plant to plant, in light rich earth, they will bloom abundantly, multiply rapidly, and make a fine appearance. They are commonly planted in lines near the edgings of flower borders, and in clumps or irregular dispositions in lawns. Their bulbs ought to be taken up, separated, and redistributed at least every three years, else they will become too crowded to obtain a proper supply of nourishment.—Seed-sowing for new varieties of crocus would be a good amusement for some idle amateurs. The seeds do best when sown fresh-gathered, and in light, dry, porous soil.

CROFT. A field in a state of commonage; also, a cottager's enclosure, usually of the size of a large field, with the cottage and a garden at one end. A croft, in the latter sense, differs little from an Irish farm, but is usually in better condition and under better management.

CROFTER. The occupant of an allotment of land, of the extent and nature of a croft. Crofters have, in numerous instances, been settled on waste lands which no ordinary farmer would rent, and

have reclaimed them, and enjoyed the fruit of their labour during periods agreed on by lease. In 1836, the Highland Society, in order to encourage the reclamation of waste lands by the settlement of crofters, offered a premium for the most satisfactory report of any previous improvement by means of crofting; and they published in their Transactions the reports of two competitors for the premium. These reports occur in the portion of the Transactions attached to the 34th No. of the Quarterly Journal of Agriculture; and are abundantly worthy of the attention of all proprietors of moorlands, heathy commons, dry upland bogs, and all similar wastes.

CRONES. Old ewes.

CROP. The quantity of any cultivated plant growing or matured on one piece of ground from one sowing or one planting. The smallest quantities of culinary vegetables grown in the beds or plots of the kitchen garden are crops; and the largest quantities of green vegetables or of esculent roots or of the cereal grasses grown on the most extensive fields of the farm are also crops. Two topics of prime interest connected with crops are the rotation of them and the causes of their occasional destruction. See the articles **ROTATION OF CROPS** and **DESTRUCTION OF CROPS**.

CROPPING. A cruel and mischievous curtailment of the ears of horses. It is effected by means of a kind of curved clams called cropping-irons, the ear being introduced to the clams, and the upper part of it cut off at one stroke with a sharp and sufficiently long knife. This barbarous operation was invented in Britain, and was at one time so common as to induce constitutional mutilation, working into some mares the habit of producing crop-eared foals; but it has of late been allowed to pass into general disuse and contempt. Not only is cropping useless and cruel, but it mars the beauty of the animal, renders him sensitive about the head, and seriously impairs his naturally fine sense of hearing.

CROPSICK. The repletion and obstruction of the stomach or 'crop' of a fowl. It frequently occurs where poultry are fed upon new corn or upon an excess of beans; and it may be relieved by gently working some of the contents of the stomach, piece by piece, upwards to the mouth, or, in an extreme case, by making a small cut into the lower part of the stomach, extracting thence a sufficient portion of the contents, and closing the wound by one or two stitches.

CROSSCUTTING. The reduction of tough sward, whether peaty or heathy, into a state of sufficient tilth for the reception of seed. When rough, mossy, or heathy land is broken up for cultivation, the plough, in any attempt at cross-ploughing, can with difficulty make its way, and carries portions of the furrows before it, and is continually liable to be thrown out. The process of crosscutting reduces this impracticable condition of the sward; and is effected by means

of a simple machine, invented about twenty years ago in the island of Islay. The characteristic parts of this machine are a series of parallel iron plates or blades, $4\frac{1}{2}$ feet long, $3\frac{1}{2}$ inches deep, and five-eighths of an inch thick at the back, made of good foreign metal, curved into segments of a circle of 40 inches in diameter, and fixed into a frame-work of oak; the main beams of this frame-work are 4 feet long, 6 inches deep, and 5 inches broad, the cross-bars are of proportional strength, and the attached shafts for commanding the machine are $6\frac{1}{2}$ feet long; and the conjoined weight of the frame-work and pressure of the driver upon the shafts force the blades into the ground, and maintain them at the proper depth in the soil. The common plough is used to break up the bog or heath land in autumn, but is caused to cut not deeper than three inches; the crosscutting-machine is worked across the furrows in the early part of winter; and the plough and the harrows afterwards complete the tilth in the ordinary methods of operation. Rough mossy land, overgrown with heath, sweetgale, and willow, and lying immediately upon clay or till, has, by this method, and with the aid of calcareous sand manure, been speedily converted into good soil for either oats or potatoes.

CROSSING. The modifying or hybridizing of the blood and form of domestic animals in breeding. Crossing sometimes signifies the use of remote males of strictly the same breed as females, in order to prevent the degenerating effects of continued in-and-in breeding; and, in this sense, it has been sufficiently discussed in our article on **BREEDING**. Crossing means also the use of males of widely different breed from that of the female, in order to produce and establish an entirely new breed; and in this sense also, it has been sufficiently discussed in our article on **BREEDING**. But crossing has likewise a meaning intermediate between these extremes, and signifies such a use of males of a different breed from that of the female as either shall improve the latter without superseding it, or shall entail upon it all the characteristic properties or excellencies of the breed of the males; and in this sense, it has very distinct and important bearings upon agricultural prosperity, and falls to be discussed in the present article. To cross from remote males of strictly one breed, with the simple effect of preventing degeneracy, can do little or no good in any of the multitudinous farms whose existing breed of sheep or cattle is essentially bad; and to cross from widely different breeds in order to produce and establish a new and good breed, is not only in the present state of stock-farming a very unnecessary process, but requires far more knowledge, wisdom, time, and capital than any one of the vast majority of stock-farmers can possibly command. Either, therefore, improvement must be pronounced unnecessary; or it can be effected only by the medium kind of crossing, which conveys to the offspring of the females of

one breed some good properties of the males of another breed.

No intelligent traveller can look at the miserable flocks which inhabit a very large proportion of the pastures of Great Britain, without feeling astonished that the necessity of improvement seems to be so limitedly recognised, and the desire for it so limitedly kindled. "Any one who takes a leisurely survey of the breeds in Scotland through the midland and northern counties," remarks Mr. Dickson, "must be satisfied that many of them are inferior to the best kinds, and that to cultivate them is just to bestow labour on that which is unprofitable. It is surely not sufficient for a farmer that he has merely a lot of cattle so called, to trample down his straw and eat his turnips, regardless of the return in flesh which these cattle may give for the meat which they consume, and the care which they require. Look around the country, and see the numbers of sharp-backed, flat-ribbed, and coarse-boned beasts which are everywhere to be seen. Such cattle have very appropriately been termed 'razor-backs.' These razor-backs, after they have devoured more good food than the better sorts, present nothing but masses of coarse beef; there is not a joint of meat in them to suit the customers of respectable butchers."

Many persons, however, have contended that the wise course is gradually to exterminate all bad breeds, by gradually supplanting them with imported individuals and droves of better breeds. But even supposing that such individuals and droves could be obtained at prices sufficiently moderate to prevent loss, and from pastures and climates sufficiently similar to prevent danger, they obviously cannot be procured in sufficient numbers to effect the desired object without enormous postponement of time, and consequent loss and other evils from delay. If no more were attempted than merely to substitute the bad breeds of the plains by imported short-horns, not only many generations of cattle but many generations of men would require to pass away before the measure could be accomplished. Such prime breeds as possess adaptation for removal to other districts than those in which they have arisen and become established, are as yet far from being numerous; and while they need to maintain and somewhat multiply their numbers in their native districts, they can produce but a comparatively small surplus for general dispersion throughout the country. But the object could speedily be accomplished by crossing: a few well-bred short-horn bulls could be promptly introduced to every little lowland region inhabited by bad breeds; many hundreds of offspring would, in a very short time, arise from each bull; a few more well-bred bulls could, after the lapse of two or three years, be introduced for the sake of the rising stock; the bullocks of the cross-bred offspring could regularly be fattened and sold off, leaving the whole field to the influence and possession of the new-

comers; and thus by several properly-timed importations of merely a few bulls, a meliorating revolution would speedily be achieved in the blood, form, habits, and 'points' of all the cattle in the district.

But all crossing must be conducted with due regard, both to the properties of the males employed in it, and to the adaptations of the offspring to the situation in which it is to be reared and kept; else the result may not only be a total and humiliating failure of all improvement, but the production of a deformed, unthriving, wretched race of mongrels, to the full as unprofitable and unsightly as the notorious 'razor-backs.' The kinds and variations of regard to be paid to the properties of the males were discussed in our article on BREEDING, and need not be farther noticed; but the kinds and variations of regard to be paid to the adaptations of the offspring, have not yet been touched by us, and are very generally overlooked or at least not duly considered by farmers, and therefore will form a fit subject of special and somewhat extended remark.

The pastures of Britain may, in a general view, and for the purpose of illustration, be distributed into the three great classes of mountainous, hilly, and champaign, each class producing its peculiar herbage, enjoying its peculiar climate, and possessing its peculiar adaptations. Mountainous pastures, for the most part, lie on non-fossiliferous rocks, or even on the hardest, most crystalline, and least disintegrable of these rocks; they produce a heathy, coarse, and scanty herbage, and rarely possess any spots of grazing ground in good feeding condition for a longer period than a few months in the warmest part of the year; they are much colder than the plains, and are prevailingly bleak and shelterless, and lift their bare summits and shoulders into fierce abrasion with every pelting storm and careering tempest; and these pastures may, on a moment's consideration, be seen to be totally unsuitable for any breed of animals which either require abundant feeding, or have a fastidious taste, or do not possess great hardiness of constitution. Even suppose a native race to be feeding and thriving on them, and to possess perfect adaptation to their herbage and climate, any crossing with it which should produce an offspring quite as hardy as itself, but considerably larger in size, would result in serious disappointment. "Where a particular race of animals has continued for centuries," says Sir John Sinclair, "it may be presumed that their constitution is adapted to the soil and climate. Any attempt, therefore, to increase the size of a native race of animals, without improving their food, by which their size is regulated, is a fruitless effort to counteract the laws of nature. In proportion to their increase of size by crossing, they become worse in form, less hardy, and more liable to disease. In every case, where the enlargement of the carcass is the object, the

cross breed must be better fed than the native parent."

The hilly pastures, in general, lie on rocks of the transition or secondary formations; they abound in natural grasses, and have a prevailing greenness of colour, and produce a sufficiency of herbage for the food of stock during the greater part of the year; yet, though much warmer and less bleak than the mountainous pastures, they suffer very considerable exposure to keen and sweeping blasts, and are, in many instances, often shrouded in fogs or drenched with rains. These pastures are well able to maintain animals of a larger size and less hardy habit than such as live upon the mountains; yet they are too chilly, too moist, and not by any means dainty enough for any of the tender and fastidious feeders of the best districts of the plains. By far the greater portion of the cattle at present found on the hilly pastures of Scotland have shaggy coats, hardy constitutions, and an unfastidious taste; and their aggregate character sufficiently hints how foolish it would be to attempt to supplant them by any very fine breed.

The champaign pastures, for the most part lie on the alluvial or tertiary formations; they enjoy the best of our country's luxuriance, shelter, and warmth; they are the scene of the cultivation of the artificial grasses, and of all the best achievements and the highest refinements of modern agriculture; and, with their rich combination of natural advantages and artificial appliances, they can almost everywhere adapt themselves to the habits and the maintenance of the largest and most tender varieties of cattle which have ever existed in our country. All the plains and valleys of the north of Scotland—of the counties of Forfar, Perth, Kincardine, Aberdeen, Elgin, Cromarty, and Caithness—as well as those of the south-east of Scotland, or of the centre and south of England, could readily support the pure short-horned breed of cattle,—if not upon their mere meadows, at least with their ample aids of green crops, lea-ground, and winter-soiling.

These three classes of pastures, the mountainous, the hilly, and the champaign, might be arranged into six, or twelve, or twenty subdivisions, each with its specific range of adaptation, and might, in consequence, be distributed into districts or sections for the maintenance of so many different groups of improved or cross-bred cattle. Yet, with probably as high advantages to agriculture as if any degree of subdivision should be practised, each might be kept entire and appropriated wholly to one race of cattle,—the mountainous pastures, to a cross between the West Highland bull and the Shetland cow,—the hilly pastures, to the offspring of the West Highland cow, slightly but not in every instance altered by crossing with the short-horn bull,—and the champaign pastures, to the offspring of the most select native cows with the best attainable short-

horn bulls. Mr. Dickson made this suggestion in 1837, and remarked, "Like the multiplicity in the varieties of the potato, there are too many varieties of breeds of cattle in this country. Were those only which are proved to be most profitable cultivated and encouraged, the agricultural interest would never feel so severely the depression in the prices of corn; nor in that case need breeders be under any apprehension of a foreign competition, even were the importation of foreign meat permitted duty free. Could I have my desire fulfilled, I should have only the three breeds which I have recommended for their respective situations throughout the whole country, namely, the cross between the West Highland and Shetland for the upper pastures, the West Highlanders or Kyloes for the middle pastures, and the short-horn for the plains for purposes of feeding; and the Ayrshire might continue as they are, or rather as they might be improved by judicious cultivation, for the purposes of the dairy, although I am not of the opinion that the Ayrshire make the best dairy cows. Could such a desideratum be consummated, breeders would then derive the greatest profit from their pastures with the least exertion, and they could always depend on their cattle acquiring the greatest weight in a given time on a given quantity of food; and this invariable result would stimulate their exertions to raise a greater quantity of food."

Crossing native cows with short-horn bulls has, for some time past, been regarded by almost all ordinary improvers as a panacea for all defects in existing breeds of cattle; and though this has often been absurdly practised without due reference, or even without any reference whatever, to adaptations of soil and climate, yet in nearly all instances upon champaign pastures, and in several instances in seemingly ungenial situations, it has more or less answered expectation, and effected very visible improvement. A rapid notice, therefore, of crossings of the short-horn bull with cows of some of the principal Scottish breeds, and of one or two other breeds in situations not the most favourable for the short-horns, can scarcely fail to be interesting and instructive.

The cross of a short-horn bull with a Shetland cow has, with common feeding, attained the weight of 45 stones, and possesses such remarkably fine quality of beef as to command the highest price in the market. The substance, symmetry, and weight of the native ox are greatly improved, and the proverbially fine quality of the beef is not deteriorated.—A cross with a North Highland cow, though much inferior to that with a Shetland cow, is a decided improvement.—A cross with a Galloway cow, a Buchan doddie, or a large-horned Aberdeenshire cow, is improved in at once weight of substance, quality of beef, and fineness of appearance. An ox, from a short-horn bull and a large-horned Aberdeenshire cow, obtained the first prize for fat, symmetry, and

weight, at the Highland Society's show at Aberdeen in 1834; and he weighed when alive 224 stones, and when dead 173½ stones.—A cross with a Fife cow loses the gaunt form of the native breed, and has a greatly increased disposition to fatten.—A cross with a West Highland cow, is very nearly equal, in both substance and symmetry, to the pure short-horn; yet though admirably successful in almost any part of the Scottish lowlands, it is ill-suited to the excessive wetness of the Hebrides and the Western Highlands.—A cross with an Ayrshire cow, in consequence of the exclusively dairy uses of the Ayrshire breed, is altogether *unadvisable*.—A cross with a long-horned Irish cow of any of the midland or the southern counties, is quickened in disposition to fatten, and has its beef of very fine quality, and thick upon the sirloin and the back.—A bullock from a short-horn bull and a Guernsey cow, and fed on distillery offals, yielded to the butcher 104 stones in his four quarters, and 22 stones of tallow. Mr. Dickson says, "I saw him when fat, and he was, without exception, the fattest bull I ever handled."—A heifer from a short-horn bull and an Indian cow was exhibited at the Highland Society's show at Kelso in 1832, and was admired by every person for fatness and extreme beauty; and her back and sirloins were well covered with beef.

The crossing of native ewes with Leicester rams has, for a considerable time past, been about as generally practised for the improvement of sheep, as the crossing of native cows with short-horn bulls for the improvement of cattle; and has been conducted with nearly the same want of discrimination, yet with much of the same preponderance of excellent result. In almost all mild situations, with tolerably good herbage, the progeny of the cross, no matter what the breed or variety of ewe, has longer wool, a finer skin, a better head, a cleaner bone, a larger carcase, and a readier disposition to fatten than the native or uncrossed race. Yet not a few instances of great disaster have happened from the folly of crossing black-faced ewes or the hardier kind of Cheviot ewes with Leicester rams in situations far too cold, coarse, and sterile to suit the comparatively tender habits and the considerably increased size of the offspring; many a signal failure has been occasioned by the shortsighted or ignorant policy of crossing only once or even twice with the Leicester ram, and then using the ram of the progeny as a sire; and calamitous instances of precisely the opposite nature have occurred of continuing the service of Leicester rams through so long a series as almost wholly to obliterate the original breed, and to establish a race of absolute Leicesters. "Every crossing," remarks Mr. Stephens, "should be prosecuted with caution, because the result may overstep the intentions of the breeder. It is clear that if the crossed stock is retained as females, which, in their turn, are served by high-

bred males, the time will arrive when the character of the original stock will be entirely changed, and become unsuited to their native climate and pasture, and will, in fact, have become the same breed as their high-bred sires. It is quite possible to originate a race of Leicester sheep anywhere suited to their nature, by constantly employing a high-bred tup to serve cross-bred gimmers, generation after generation; and were this practice generally adopted, the time would arrive when the original breeds which were crossed would disappear altogether. Such a result would prove injurious to the breeder himself, inasmuch as the pasture would be unsuited for the stock he had caused to be produced; so that his best plan is to preserve the original breeds in the higher parts of the country, and take the crosses to the low country to be fed off. The temptation of larger profits has already caused the Cheviot to drive the black-faced breed from the lower pastures to the highest, while the cross-bred Cheviot with the Leicester have descended, on the other hand, to the low country, and there have met the true-bred Leicester. This result, upon the whole, has done good, as it has increased the quantity of mutton in the market; and the skilful pasturage which the hills have received since a regular system of breeding has been introduced, has caused them to yield a larger quantity of finer grasses."

In conclusion, let it be strongly impressed on all improvers of cattle and sheep by crossing, that the use of cross-bred bulls or rams, particularly such as are of merely the first or the second generation, is in all respects injudicious, and very often exceedingly disastrous. The use of a cross-bred bull or ram among even the race to which he belongs, or on the farm on which he has been bred, may more than counteract all the benefits of the original crossing, or may originate a progeny considerably more defective in aggregate character than the uncrossed and unimproved race; and the use of a cross-bred bull or ram among a breed of different points and different situation than that of his own female ancestry, is simply to produce mongrels from a mongrel, to destroy all distinctions of breed, probably to elicit an assemblage of motley and misshapen animals, and certainly to enact a broad and grinning burlesque upon the whole theory of crossing.—*Papers by Mr. Dickson of Edinburgh, Mr. Ferguson of Woodhill, and Mr. Hogg of Stobo in Quarterly Journal of Agriculture.*—*Sir John Sinclair's Code of Agriculture.*—*Sproule's Agriculture.*—*Stephen's Book of the Farm.*—*Transactions of the Highland Society.*—*Journal of the Royal Agricultural Society of England.*

CROSSWORT,—botanically *Crucianella*. A genus of curious, low-growing plants, of the madder tribe. The maritime and the American species are half-tender, yellow-flowering, evergreen undershrubs, of about a foot in height; and seven or eight annual species, and about the

same number of perennial-rooted herbaceous species, all hardy, and varying in height from 4 to 15 inches, occur in British collections of hardy exotics. The narrow-leaved crosswort, *Crucianella angustifolia*, is one of the best known of the annual species, and was brought from the south of France about the middle of the 17th century. Its stems are erect, several in number from one root, and about a foot high; its leaves are linear and very narrow, and occur in a whorl of 6 or 7 at each joint; and its flowers grow in loose spikes at the top and from the sides of the branches, are small, whitish-yellow, and inconspicuous, and appear in June and July. Two or three of the perennial species are well adapted for rockwork.

CROSSWORT,—botanically *Valantia Cruciata*. A beautiful, indigenous, perennial, trailing, herbaceous plant, of the madder tribe. It is ranked by some botanists as a bedstraw, and called *Galium cruciatum*. It grows wild in many moist and fertile soils of Britain. Its stems are pale green, square, hairy, and about 20 inches high; its leaves are short and broad, and grow in fours in a 'crosswort' manner at each joint of the stem; and its flowers are small and yellow, grow in clusters or corymbs of eight in each floral footstalk, and appear in May, and sometimes bloom throughout the summer. This plant possesses astringent properties.

CROTALARIA. A large genus of papilionaceous plants, of the broom division of the lotus section of the leguminous order. About 150 species have been scientifically described; and about 90 of these occur in British collections. All the introduced species are more or less tender; by far the greater number are tropical; and about one-half are Indian. About thirty are evergreen shrubs and undershrubs; five or six are evergreen herbs; one is tuberous-rooted; and upwards of one-half are annuals. Two or three are economical; about one-half are more or less ornamental; and the rest possess interest only to botanists.—The warted species, *C. verrucosa*, called by Jacquin *C. cœrulea*, is an annual of both of the Indies, and was introduced to Britain in the third decad of last century. Its stem is quadrangular and about 20 inches high, and divides into three or four acutely quadrangular branches; its leaves are oval, watered, pale green, and briefly petiolate; its flowers are produced in spikes at the end of the branches, have a light blue colour, and appear in July and August; and its pods are short and turgid, and enclose each one-row of kidney-shaped seeds. The juice of the leaves of this plant is supposed, in India, to be efficacious in diminishing salivation.—The rush-stalked species, *C. juncea*, is also an annual and a native of India, and was introduced to Britain at the beginning of the 18th century. It attains about the same height as the preceding species, but has a tough, stringy, fibrous stem, and carries yellow-coloured flowers. It possesses great

economical value in the lower provinces of India; it is sometimes called Indian hemp; and it furnishes, in the fibres of its stem, material for cordage, bullock saddles, grain bags, and other useful articles.—The generic name *Crotalaria* is formed from a word which signifies a rattle or castanet; and it alludes to the rattling of the seeds in the pod.

CROTON. A very diversified genus of plants, of the euphorbia order. *Tiglim* or the purging species, *Croton Tiglim*, is a native of most parts of India, and was introduced to the hothouses of Britain toward the close of last century. It is an evergreen shrub, and usually attains a height of about 10 or 12 feet. Its stem is covered with a soft, blackish bark; its leaves are petiolate, alternate, pointedly ovate, serrated, and smooth; its flowers have a whitish-green colour, and grow in erect terminal spikes or racemes, and appear in August and September; and its seeds grow in trilocular capsules, and are oblong, four-sided, about the size of large coffee-beans, and covered with a soft and yellowish skin. The whole of this plant possesses the properties of a most acrid, drastic, and otherwise powerful cathartic. Its very wood is remarkably pungent and purgative. Its leaves are so acrid and stimulating, as, when chewed, to inflame the mouth and throat, and to produce a sensation of burning, not only in the stomach, but through the whole of the intestinal canal. Its seeds, in particular, are one of the most dangerously purgative medicines in existence; from half a score to a score of them have been known to purge a horse to death; and on account of their dreadfully drastic power, and while they were known in commerce under the name of Molucca grains, they were discarded from the materia medica of Europe. A well known fixed oil, however, which is obtained from the seeds by expression, and which contains all their active properties, and possesses adaptation to mild and cautious methods of exhibition, has taken their place in medicine, and is frequently administered, in an emulsive form, to the human subject, in cases of apoplexy, mania, convulsion, excessive constipation, and other cases requiring rapid and hydragogic action. Croton oil has a pale reddish-yellow colour, and consists of 45 per cent. of the peculiar acrid principle of the seeds and 55 of a fixed oil similar to the oil of olives; but, in very many instances, it is most shamefully adulterated. Either the oil itself, or more frequently the freshly-pulverized mass or farina of the seeds, is sometimes given to horses and cattle in cases of staggers, locked-jaw, and dropsy. But whenever internally administered to horses or cattle, and above all to human beings, it demands such scientific caution as no person but an experienced practitioner can possibly possess. The oil, diluted with oil of olives, is sometimes a good external application, for raising pustules and acting generally as a counter-irritant.

The *Eleuteria* species or sea-side balsam, *Croton Eleuteria*, furnishes the cascarilla bark of the drug shops. See the article *CASCARILLA*.—The dyer's species, *Croton tinctoria*, is a hardy annual,—the only hardy species known; and was brought from the south of Europe in the latter part of the 16th century. But Willdenow separated it from the crotons, and assigned it to a new genus. See the article *CROZOPHORA*.—Four other species which have been introduced to Britain are uninteresting hothouse annuals; four or five are somewhat handsome, hothouse, evergreen shrubs; and the rest, amounting to about twenty-five, are tender evergreen shrubs of very little interest.—Upwards of 120 unIntroduced species have been described by botanists; and some of these are known to exude gummy or resinous matters, of either curious properties or considerable mercantile value.

CROW. A genus of birds remarkable for their gregarious and predatory habits, distinguished by the following characters: The bill is straight, convex, and compressed, being covered at its base by incumbent, bristly feathers; the upper mandible is curved at tip, the lower is a little shorter, carinated on both sides, and slightly ascending at the extremity; the nostrils are placed on the base of the bill, and are patulous, though covered by the incumbent feathers; the tongue is short, cartilaginous, acute and bifid at tip; the tarsus scarcely exceeds the middle toe in length; the toes are separated almost to the base, and the middle one is the longest; the nails are moderate, pointed, hollow beneath, and sharp-edged, the hind one being generally longest; the wings are subelongated, acute, the first primary short, third or fourth longest; the tail consists of twelve feathers. The members of the genus are very extensively spread over the globe, and are almost equally distinguished for their remarkable sagacity, and the amount of mischief which they occasion where they are very numerous.

The husbandman, or farmer, is often unconscious of the good these industrious birds do for him at all seasons, except only in long-continued drought, when the insects descend into the earth, and when its surface becomes so hard as to defy the efforts of the rooks to dig the larvae out. At such times, indeed, when their natural instincts are neutralized, and when hunger craves, they will in troops fall upon a field of wheat or barley just ripening, and where they will do considerable damage if not scared-off by a sentinel with his racket, or by hanging rags, dipped in melted brimstone, on sticks about the field. But the farmer is unwilling, for this their thievish crime, to agree that they are otherwise serviceable to him, because he can see where the rooks have been at work; single plants of wheat or grass actually pulled out of the ground, which to him appears another unpardonable offence. But if he would examine such depredations closely, he would find that the bird had only pulled up a

sickly plant, to reach the grub that was feasting on its roots, and which, but for the rook, would have disrooted many more. The farmer knows well the injury he suffers from the wire-worm, an insect more or less plentiful in every season, especially in old leas when newly broken up. Now, the larvae of this beetle, together with those of all the chafer, are in the estimation of the rook the sweetest morsels he can meet with, and, led by his keen sense of scent, he will dig them out of the ground though an inch or two below the surface. And as the question concerning the good or bad properties of the rook to the farmers is very differently believed, let any one who has doubts shoot, or have one shot for him, when the bird is on his way home from the feeding ground. Let him open the provision pouch and look at the contents; this he will find consists entirely of the larvae of insects, which are bred and fed on the roots of plants in the ground. In this great and good service the rook is assisted by the jackdaw and starling, which are almost always seen associated on places where grubs abound.

Mr. Knapp, in his 'Journal of a Naturalist,' has taken a pleasing and favourable view of the rook.—Gesner—he says—"has called the common rook, *Corvus frugilegus*, 'a corn-eating bird.' Linnæus has somewhat lightened this epithet by considering it only as a gatherer of corn; to neither of which names do I believe it entitled, as it appears to live solely upon grubs, various insects, and worms. It has at times great difficulty to support its life, and in a dry spring or summer most of these are hidden in the earth beyond its reach, except at those uncertain periods when the grub of the chafer is to be found; and in a hot day we see the poor birds perambulating the fields, and wandering by the sides of the highways, seeking for and feeding upon grasshoppers, or any casual nourishment that may be found. At those times, were it not for its breakfast of dew worms, which it catches in the grey of the morning, as it is appointed the earliest of risers, it would commonly be famished. In the hot summer of 1825, many of the young brood of the season perished from want; the mornings were without dew, and consequently few or no worms were to be obtained; and we found them dead under the trees, having expired on their roostings. It was particularly distressing, for no relief could be given, to hear the constant clamour and importunity of the young for food. The old birds seemed to suffer without complaint; but the wants of their offspring were expressed by the unceasing cry of hunger, and pursuit of their parents for supply, and our fields were scenes of daily restlessness and lament. Yet, amid all this distress, it was pleasing to observe the perseverance of the old birds in the endeavour to relieve their famishing families, as many of them remained out searching for food quite in the dusk, and returning to their roosts long after the usual period for retiring. In this extremity it becomes

a plunderer, to which by inclination it is not much addicted, and resorts to our newly-set potato fields, digging out the cuttings. Banks are seen sadly defective, the result of its labours, I fear; and the request of my neighbours now and then for a bird from my rookery, to hang up *in terrorem* in their fields, is confirmatory of its bad name. In autumn a ripe pear, or a walnut, becomes an irresistible temptation, and it will occasionally obtain a good share of these fruits. In hard frost it is pinched again, visits for food the banks of streams, and in conjunction with its congener, the 'villain crow,' becomes a wayfaring bird, and 'seeks a dole from every passing steed.' Its life, however, is not always dark and sombre; it has its periods of festivity also. When the waters retire from meadows and low lands, where they have remained any time, a luxurious banquet is provided for this corvus, in the multitude of worms which it finds drowned on them. But its jubilee is the season of the cockchaffer, *Melolantha vulgaris*, when every little copse, every oak, becomes animated with it and all its noisy joyful family feeding and scrambling for the insect food. The power or faculty, be it by the scent, or by other means, that rooks possess of discovering their food, is very remarkable. I have often observed them alight on a pasture of uniform verdure, and exhibiting no sensible appearance of withering or decay, and immediately commence stocking up the ground. Upon investigating the object of their operations, I have found many heads of plantains, the little autumnal dandelions, and other plants drawn out of the ground and scattered about, their roots having been eaten off by a grub, leaving only a crown of leaves upon the surface. This grub beneath, in the earth, the rooks had detected in their flight, and descended to feed on it, first pulling up the plant which concealed it, and then drawing the larvæ from their holes. By what intimation this bird had discovered its hidden food we are at a loss to conjecture; but the rook has always been supposed to scent matters with great discrimination.

"It is but simple justice to these often-censured birds, to mention the service that they at times perform for us in our pasture-lands. There is no plant that I endeavour to root out with more persistency in these places than the tuft-hair grass, *Aira caespitosa*. It abounds in all the colder parts of our grass-lands, increasing greatly when undisturbed, and, worthless in itself, overpowers its more valuable neighbours. The larger tufts we pretty well get rid off; but multitudes of small roots are so interwoven with the pasture herbage, that we cannot separate them without injury; and these our persevering rooks stock up for us in such quantities, that in some seasons the fields are strewed with the eradicated plants. The whole so torn up does not exclusively prove to be the hair-grass, but infinitely the larger portion consists of this injurious plant. The object

of the bird in performing this service for us, is to obtain the larvæ of several species of insects, underground feeders, that prey on the roots, as Linnaeus long ago observed upon the subject of the little nard grass, *Nardus stricta*. This benefit is partly a joint operation: the grub eats the root, but not often so effectually as to destroy the plant, which easily roots itself anew: but the rook finishes the affair by pulling it up to get at the larvæ, and thus prevents all vegetation; nor do I believe that the bird ever removes a specimen that has not already been eaten, or commenced upon, by the caterpillar."

The rook makes a large nest of twigs, lined with wool, hay, and other soft matters, lays four or five spotted eggs, and when the young are half-grown they leave the nest, and sit to be fed on the branches around; the young are then called *branchers*; and then it is that the gunners have a battue, and a day of slaughter of the helpless young. This cruelty is justified as a means of preventing an over-abundance of those birds; for, notwithstanding all that has been heretofore said in favour of the rooks, there are many farmers who still think they are more injurious than serviceable. In winter, when the frost has hardened the ground, or when it is covered with snow, the poor rooks have a hard struggle to live; they are completely shut out from their natural food, and then they are compelled to be thieves, invading the rick-yards, and striving with the farm-yard poultry for a share of their grain. In such seasons many of the old rooks die of cold and hunger; and then, too, the most vigorous of them have a new propensity—becoming herbivorous or granivorous, rather than insectivorous.

It has been said that farmers in the United States of America suffer much loss of their field crops from the depredations of ground insects; attributing these losses to the circumstance of there being no rooks in that country. So seriously is this circumstance believed, that attempts have been made to introduce the rook into Virginia, but hitherto without success. In Scotland the rooks are commonly called *crows*, and in Yorkshire they are called *crakes*, and in both these countries are wrongfully accused of devouring grain at all seasons. Both these provincial names are corruptions of crow, the name of a bird, which, though wearing the same livery, is a being of a very different character.

"The crow," says Mr. Wilson in his 'American Ornithology,' "is perhaps the most generally known, and least beloved, of all our land-birds; having neither melody of song, nor beauty of plumage, nor excellence of flesh, nor civility of manners, to recommend him; on the contrary, he is branded as a thief and a plunderer,—a kind of black-coated vagabond, who hovers over the fields of the industrious, fattening on their labours; and, by his voracity, often blasting their expectations. Hated as he is by the farmer,

watched and persecuted by almost every bearer of a gun, who all triumph in his destruction, had not Heaven bestowed on him intelligence and sagacity far beyond common, there is reason to believe that the whole tribe would long ago have ceased to exist. It is in the month of May, and until the middle of June, that the crow is most destructive to the corn-fields, digging up the newly planted grains of maize, pulling up by the roots those that have begun to vegetate, and thus frequently obliging the farmer to replant, or lose the benefit of the soil; and this sometimes twice, and even three times, occasioning a considerable additional expense, and inequality of harvest. No mercy is now shown him. The myriads of worms, moles, mice, caterpillars, grubs, and beetles, which he has destroyed, are altogether overlooked on these occasions. Detected in robbing the hens' nests, pulling up the corn, and killing the young chickens, he is considered as an outlaw, and sentenced to destruction. But the great difficulty is, how to put this sentence in execution. In vain the gunner skulks along the hedges and fences; his faithful sentinels, planted on some commanding point, raise the alarm, and disappoint vengeance of its object. The coast again clear, he returns once more in silence to finish the repast he had begun."

CROWBERRY,—botanically *Empetrum*. A genus of small, dwarfish, heath-like shrubs, constituting the type of the natural order Empetreae. This order consists wholly of such shrubs, and comprises, within Great Britain and its gardens, only three species, belonging to three genera, *empetrum*, *ceratiola*, and *corema*. The species belonging to the *empetrum* genus, *E. nigrum*, is a dwarfish, evergreen, undershrub, and grows wild upon the mountains of Staffordshire, Derbyshire, and Yorkshire. It loves a lofty, bleak, semi-alpine, peaty, rocky situation, and attracts and feeds multitudes of heath-cocks with its berries. It grows about a foot high, and carries apetalous flowers in April and May. It can be cultivated in stiff soil under the shade of trees or shrubs in gardens.

CROWEA. A small genus of very beautiful, greenhouse, Australian, evergreen shrubs, of the correa division of the rue order. Two species, *C. saligna*, and *C. latifolia*, have been introduced to Britain, and both grow about 4 feet high, and carry a profusion of showy purple-coloured flowers in autumn; and though rather shy and fastidious, can with a little care be propagated from cuttings and maintained in luxuriantly blooming condition. In 1837, a four-year old plant of *C. saligna* was exhibited at the Egyptian Hall in London, nearly five feet high, and carrying not fewer than two hundred fully expanded flowers.

CROWFOOT. The indigenous species of the genus *ranunculus*. See the article **RANUNCULUS**. The bulbous-rooted crowfoot, *Ranunculus bulbosus*, is the beautiful and universally diffused buttercup of British meadows and pastures. See the

article **BUTTERCUP**. The corn crowfoot, *R. arvensis*, is an annual weed of our corn-fields. Its root is fibrous; its stem is erect, and about a foot high; its leaves have a pale shining green colour, and are cut into long, acute, narrow segments; its flowers are smaller and paler than those of the buttercup, and have a lemon colour, and appear from June till August; and its carpels are all over rough with little prickles. It is readily eaten by cattle, but is very dangerous to them, and possesses so much acridity that three ounces of its juice will kill a dog in less than two minutes.—The small-flowered crowfoot, *R. parviflorus*, is also an annual weed; and is very similar in character to the corn crowfoot, but is neither so common nor so tall, and has a preference for gravelly pastures, and either occurs not at all or very rarely in Scotland.—The little upright crowfoot, *C. parvulus*, is also an annual, cut-leaved, prickly-carpelled weed like the corn crowfoot, but has a height of only 3 or 4 inches.

The flame spearwort crowfoot, or lesser spearwort, *R. flammula*, is a perennial-rooted herb of moist and marshy waste places in both England and Scotland. Its root consists of fascicles of long, simple fibres; its stems are round, smooth, branching, leafy, about a foot high, and somewhat decumbent; its leaves are alternate, lanceolate, pointed, smooth, either entire or slightly serrated, and stand on long footstalks; its flowers are solitary, have a bright shining yellow colour, and appear from June till September; and its carpels are smooth, ovate, and roundish. The whole plant is acrid, caustic, and poisonous; it loses some of its acrimony by drying, and the whole of it by boiling; the distilled water is an emetic antidote to poison; and the fresh plant is used in medicine as an external application for irritating the skin and drawing off surrounding humours.—The creeping spearwort crowfoot, *R. reptans*, is a curious, evergreen, herbaceous, acrid creeper, of similar botanical character, and of similar choice of habitat to the preceding species.—The tongue-leaved crowfoot, *R. lingua*, is a perennial-rooted, two-feet-high, entire-leaved, yellow-flowered, acrid and caustic herb, of muddy ditches in both England and Scotland.—The alpine crowfoot, *R. alpestris*, is a small, handsome, cut-leaved, white-flowered, three-inch-high, perennial-rooted inhabitant of mountain water-courses in the Scottish Highlands.

The acrid or upright meadow crowfoot, *R. acris*, is a perennial-rooted, caustic, medicinal, dangerous weed, of the meadows, pastures, and waste places of Britain. Its root is a tuber with fibrous appendages; its stem is erect, somewhat villous, sparsely leafy, about two feet high, and branching at the top; its leaves are cut variously into three, five, or more parts; and its flowers are terminal, large, and of a brilliant yellow colour, and appear in June and July. This plant is usually rejected by even the most hungry cattle; and when unavoidably eaten, has a malign effect.

Its leaves are medicinally used in the same manner and for the same purposes as those of the flame spearwort crowfoot. A double-flowered variety of British origin, and two varieties, called the wood and the many-cleft, from continental Europe, are cultivated as ornaments of the flower-border.—The noxious crowfoot, *R. sceleratus*, is a poisonous, cut-leaved, yellow-flowered, two-feet-high annual, of waste grounds in both England and Scotland.—The creeping crowfoot, *R. repens*, is a low, creeping, perennial-rooted, cut-leaved, yellow-flowered weed, of British meadows and pastures. It blooms through nearly all the summer and through part of autumn; and a double-flowered variety of it has long had a place in flower-gardens.—The hairy crowfoot, *R. hirsutus*, is an annual weed of about a foot high, growing amongst stony rubbish in some parts of England.—The blunt-flowered, the ivy-leaved, the water, and the all-hairy crowfoots, *R. obtusiflorus*, *R.hederaceus*, *R. aquatilis*, and *R. pantothrix*, are handsome, white-flowered, floating, perennial aquatics of ditches and ponds in Britain.

CROWN-IMPERIAL,—botanically *Fritillaria Imperialis*. A hardy, bulbous-rooted, magnificently-flowering plant, of the tulipaceous tribe. It was introduced to Britain from Persia toward the close of the 16th century; and it occupies a prominent place, in almost every flower-garden, as one of the most showy and large-featured of florists' flowers. Its bulb is large, globose, scaly, yellow-coloured, and powerfully fetid; its stem is herbaceous, succulent, of very rapid growth, and about 4 feet high,—its lower and middle parts garnished, on every side, with long, narrow, pointed, smooth, entire leaves,—its upper part, or about a foot of it toward the summit, quite naked, and crowned first with a massive and most imposing whorl of flowers, and next with a terminal and spreading tuft of erect, green leaves; and its flowers are produced in a whorl or occasionally in two or even three whorls of inverted bells,—they are large and spreadingly campanulate, and hang upon short, bent peduncles which grow at the interstices of the terminal or crowning tuft of leaves,—and each comprises six spear-shaped petals, and has at the base of each of these a nectary filled with a honeyed liquor, and looking like a liquid globular gem. Twelve well-defined varieties, besides many fugitive ones, were known in the days of Miller; and very numerous varieties, with similar fancy names to those which are given to tulips and hyacinths, figure in the seedsmen's annual lists of Dutch roots. "The sort with yellow flowers, that with large flowers, and those with double flowers," says Miller, "are the most valuable; but that which hath two or three whorls of flowers above each other makes the finest appearance, though this seldom produces its flowers after this manner the first year after removing, but the second or third year after planting, the stalks will be taller, and frequently have three tiers of flowers one above the other,

which is called the triple crown." The crown-imperial is treated in a similar manner to other hardy and unfastidious bulbous-rooted plants, but ought not to be removed so often, and requires to be planted at a depth and distances somewhat proportioned to its greater size. See the article FRITILLARY.

CROWN-SCAB. A disease of the coronet of the feet of horses. It consists of an outbreak of bad humour round the coronet, accompanied with a very sharp itchiness, and followed by the formation of scab. A drawing and healing ointment may be applied, and a dose or two of physic given.

CROWN-VETCH,—botanically *Coronilla varia*. A hardy, herbaceous, perennial-rooted forage plant, of the *Coronilla* genus. It is a native of continental Europe, and was introduced to Britain toward the close of the 16th century. Its roots have a powerfully creeping habit; its stem is smooth and about a yard long, and declines toward the base when mature; its leaves are compound, smooth, and long; and its flowers are produced in round heads, and have a variegated pink colour, and bloom from July till November. This plant loves a warm, dry, light soil, and will yield two very large crops of green fodder in a season; but it has a bitterish taste, and is not much relished by cattle, and is unfitted by the excessively creeping habit of its roots for profitable culture on any ground which can be subjected to ordinary cropping.

CROZOPHORA. A recently constituted genus of plants of the euphorbia tribe. The dyer's species, *Crozophora tinctoria*, formerly called *Croton tinctoria*, is a small, prostrate, hardy annual, and was introduced to Britain from the south of Europe in the 16th century. Its stem is slender, cylindrical, and about a yard high; its leaves are alternate, oval, soft in texture, and curled at the edge; its flowers are produced in short clusters, have a small size and a whitish-green colour, and appear in July; and its fruit droops, and comprises three rough, blackish cells. This plant resembles the crotons and some other of the euphorbiaceæ in acrid, emetic, and powerfully drastic properties; but it produces the deep purple dye called turnsole, and, for the sake of this, is cultivated in the district around Montpellier. Nearly a dozen other species have been botanically described.

CRUCIANELLA. See CROSSWORT.

CRUCIFEROUS PLANTS. A very extensive, very important, and perfectly natural assemblage of plants, constituting the class *Tetradynamia* in the system of Linnæus, and the order *Crucifera* in the system of Jussieu. About 2,500 species have been scientifically described; and about 800 of these either grow wild in Britain or have been introduced to it from foreign countries. Four-fifths of the whole order are distributed throughout the temperate regions of the world, and are impatient alike of the heat of the tropics

and the cold of the arctic zone; and a very large proportion, particularly of the most useful genera, are natives of the several countries of Europe. About eight times as many exist in the northern hemisphere as in the southern; and about ten times as many in the old world, inclusive of Polynesia, as in the new. A few ascend near the limits of perpetual snow; a considerable number love only waste and open grounds unvisited by man; and many range far and wide through the domains of agriculture, either as useful plants or as troublesome weeds.

The roots of almost all the perennial species are thick; and those of almost all the biennial and the annual species are slender, straight, and unforked. The stems of most are either cylindrical or not very markedly angular, and have a ramose conformation, and are woody at the base. The leaves of all are simple, and of almost all are either radical or alternate. The flowers of all are without bracts, and have a calyx of four sepals, and a corolla of four petals and six stamens; and the claws of the petals are long,—the blades of the petals are arranged somewhat in the form of a Maltese cross, and hence gave to the order the designation of *Cruciferae* or 'cross-bearers,'—and four of the stamens are shorter than the other two, and hence give to the class the name of *Tetradynamia*. The fruits are very various in form, yet are easily classifiable into *siliqua* and *silicula*,—the former a linear or long and slender pod containing many seeds, and the latter a short and roundish pod containing one seed or very few seeds; and hence the Linnæan class *Tetradynamia* is made to consist of two divisions, called *Siliculosæ* and *Siliculosæ*. The multitudinousness of the species, and the close resemblances of very many of them to one another, long rendered the order intractable to systematic arrangement, and perfectly bewildering to students. But De Candolle observed certain constant differential characters in the mutual relations of the cotyledons and the radicles; and adopting these as differentia, lucidly broke up the whole assemblage into five suborders. Plants which have the edge of the cotyledons pressed close to the radicle belong to the suborder *Pleurorhizæ*; those which have the sides of the cotyledons pressed to the radicle belong to the suborder *Notorhizæ*; those which have the cotyledons incumbent and at the same time conduplicate, or half folded together, belong to the suborder *Orthoplocæ*; those which have the cotyledons incumbent and at the same time spirally twisted belong to the suborder *Spirolobæ*; and those which have the cotyledons incumbent and at the same time doubled twice in their length belong to the suborder *Diplecolobæ*. The species within Britain are grouped into 88 genera; and 44 of these genera belong to the first suborder, 21 to the second, 18 to the third, 2 to the fourth, and 3 to the fifth. But 39 of the *Pleurorhizæ* genera form three groups, which

are represented by respectively the wall-cress, the alyssum, and the shepherd's purse; 17 of the *Notorhizæ* genera form three groups, which are represented by respectively rocket, garden-cress, and woad; and 17 of the *Orthoplocæ* genera form four groups, which are represented by respectively cabbage, cress-rocket, radish, and zilla.

A pungent, volatile, oily principle, whose chemical constitution and characters are imperfectly known, more or less pervades the sap of all the cruciferae; and when in excess, renders them acrid to the animal palate, and violent in action upon the animal,—but, when in moderate degree, either from the constitutional peculiarity of the plants, or from the effects of cultivation, renders them piquant and grateful to the taste, and eminently antiscorbutic in medicinal effect. The existence of this principle, in a very hot yet palatable condition, is familiarly known in the seeds of the mustard-plant and in the roots of horse-radish; the action of it, in an agreeably piquant manner, gives their peculiar relish to the foliage of the cresses; and the moderate diffusion and mild power of it occasion much of the gratefulness of the cruciferous esculents, and account for the efficiency of scurvy-grass, radishes, turnips, and the whole of the cabbage tribe in curing or preventing scurvy. All cruciferous plants which have a succulent and sappy character, such as turnips, radishes, and cabbages, are edible; and some which are disagreeably or too violently pungent, are capable of being made milder by ordinary cultivation or by blanching. A fixed oil occurs in the seeds of all, and abounds in the seeds of many; and this, as in the case of the rape, the colza, and various others, can be profitably expressed in large quantity, and applied to the economical purposes of life. Some cruciferae, such as the wall-flowers, the candytufts, the rockets, and the stocks, are among the most prominent, beautiful, and odoriferous of the hardy plants of the flower-garden; many more, such as those of the genera *arabis*, *alysum*, *aubrietia*, *barbarea*, *lunaria*, and *schizopetalon*, are subordinate yet important beauties; and some, such as the *drabas*, the *cardamines*, and the *hutchinsias*, are among the most fascinating specimens of alpine plants.

CRUPPER. An appendage to a saddle, consisting of a roll of leather placed beneath the horse's tail, and a strap of leather attaching this to a buckle on the hinder part of the saddle.

CRUSHER. See **BRUISING**.

CRYPsis. A genus of grasses, of the *phalaris* or *phleum* tribe. Three hardy annual species have been introduced to Britain from continental Europe; but they attain a height of only 6 or 8 inches, and possess very little interest. Five other species have been scientifically described. The name *Crypsis* signifies 'hidden,' and alludes to the concealment of the flowers among the leaves.

CRYPTADENIA. A small genus of curious,

ornamental, Cape-of-Good-Hope, evergreen undershrubs, of the wild-olive tribe. Three species, *C. uniflora*, *C. grandiflora*, and *C. ciliata*, formerly belonging to the genus *Passerina*, were detached from that genus, and erected into the genus *Cryptadenia*, by Professor Meisner. The name *Cryptadenia* alludes to 'the concealed glands,' which are situated within the tube of the flower. *C. uniflora* was introduced to Britain so long ago as the year 1759, and has ever since been cultivated in the royal garden at Kew; and it possesses considerable beauty, carries a profusion of flowers, and continues somewhat long in bloom; yet it is still scarce and but little known. Its stem and branches have a twiggy and heath-like appearance, and rarely attain a greater height than 8 or 9 inches; its leaves are linear and acute; and its flowers are produced singly at the ends of the numerous little twigs, and are pinkish-lilac and hypocrateriform, each having a small narrow tube, and a spreading limb of four ovate acute segments.

CRYPTANDRA. A genus of curious, ornamental, Australian, evergreen undershrubs, of the buckthorn tribe. The sweet-scented species, *C. suavis*, was introduced from the Swan river in 1844. Its form is neat; its leaves are small and ovate-oblong; and its flowers are small, white, campanulate, and drooping,—they exist in profusion over all the side-branches,—they are individually insignificant, but aggregately conspicuous,—and they bloom in January, and are as fragrant as the flowers of the hawthorn. Five other species were introduced during the twenty years preceding 1838, and four of these are white-flowered and about 20 inches in height. The generic name alludes to the concealed position of the stamens.

CRYPTOGAMOUS PLANTS, or CRYPTOGRAMIA. Plants whose organs of fructification cannot be seen by the naked eye, or are otherwise obscure and 'concealed.' They are contradistinguished from phænogamous plants, or such as have their organs of fructification 'manifest;' they constitute the last or twenty-fourth class in the Linnæan arrangement; and they are nearly identical with the Acotyledons and the Cellulares of the natural systems of botany. See the articles **ACOTYLEDONOUS PLANTS** and **CELLULARES**. The Cryptogamia are distributed, in Linnæan botany, into the nine orders Filices, Equisetaceæ, Lycopodiaceæ, Marsileaceæ, Musci, Hepaticæ, Algæ, Lichenes, and Fungi.

CRYPTORHYNCHUS. A genus of coleopterous insects, of the weevil group. One of its species, *C. lapathi*, commits great depredation upon trees and osiers in the south of England. It is nearly half an inch long, and of a dull black colour, with a band of white scales across the base and the apex of its elytra. It bores cylindrical holes in the stems and the larger branches of willows, alders, and other aquatic trees; and these holes so admit the moisture of the atmo-

sphere, and accelerate the decomposition of the woody tissue, as to occasion the overthrow of many trees by gales of wind. The same kind of mischief is perpetrated by the caterpillar of the goat-moth, and by several other larvæ; and all these, on this account, are popularly designated "auger-worms."

CUBE, in geometry. A solid body, consisting of six equal square sides. The solidity of any cube is found by multiplying the superficial area of one of the sides by the height.

CUBE, or **Cubic Number**, in arithmetic. That which is produced by the multiplication of a square number by its root; thus 64 is a cube number, and arises by multiplying 16, the square of 4, by the root 4.

CUBE ROOT. A number or quantity, which, if multiplied into itself, and then again by the product thence arising, gives a product equal to the number or quantity whereof it is the cube root; as, 2 is the cube root of 8, because twice 2 are 4, and twice 4 are 8.

CUBEBS. The dried berries of a tropical plant, of the pepper genus,—*Piper cubeba*. This plant grows in great abundance in Java, and is also a native of Batavia, Nepaul, the Mauritius, and Guinea. When young, its branches are long, creeping, and stoloniferous, and its leaves are about an inch and a half in length, and have footstalks as long as themselves; but when old, its branches are quadrangular and flexuose, and its leaves are not quite an inch in length, and have channelled footstalks of only about half an inch in length. The berries grow in clusters; they are round, plump, heavy, and about the size of pease; they have a grateful fragrance, and an aromatic, pungent, slightly bitter taste; they possess stimulating, diuretic, and slightly purgative properties; and they are used in the East as a spice and a stomachic, and in Europe for the cure of venereal diseases.

CUBIT, in the mensuration of the ancients; a long measure, equal to the length of a man's arm, from the elbow to the tip of the fingers. Doctor Arbuthnot makes the English cubit equal to 18 inches, the Roman cubit equal to 1 foot, 5·406 inches, and the cubit of scripture equal to 1 foot, 9·888 inches.

CUCKOO. A genus of birds, characterized by a bill of moderate size, short tarsi, and tail composed of ten feathers. The bill is compressed, and slightly arched. The greater number of species belonging to this genus are found on the ancient continent. Only one species is a native of Great Britain, and very few belong to Europe. In America no true cuckoos are found, for the genus *coccyzus* differs very essentially from them in its habits. The cuckoos are especially distinguished by their habit of laying their eggs in the nests of other, and generally much smaller birds. What is still more singular, it has been found, by very careful observations, that the young cuckoo, shortly after being hatched, throws out

of the nest all the other young or eggs, and thus engrosses to itself the whole parental care of the bird in whose nest it has been lodged. The colour of the cuckoo's eggs is extremely variable. Some, both in ground and pencilling, very much resemble the house-sparrow's; some are indistinctly covered with bran-coloured spots; and others are marked with lines of black, resembling in some measure the eggs of the yellow-hammer. The cuckoo first appears in England about the 17th of April. Its egg is not ready for incubation sooner than the middle of May. A fortnight is taken up by the sitting bird in hatching the egg. The bird generally continues three weeks in the nest before it flies. The foster parents feed it for more than five weeks after this period; so that, if the cuckoo took care of its own eggs and young, the newly-hatched bird would not be fit to provide for itself before its parent would be instinctively directed to seek a new residence, and be thus compelled to abandon its young one; for the old cuckoos take their final leave before the first week in July. The young cuckoos forsake the nest as soon as fully fledged, and capable of providing for themselves. Their migrations from Europe are thought to be chiefly directed towards Africa; thence they regularly return with the spring.

CUCKOO-FLOWER, — botanically *Lychnis Flos-cuculi*. A beautifully-flowering, indigenous, perennial-rooted, herbaceous plant, of the carnation tribe. It grows wild in the moist meadows of both England and Scotland; and has a considerable resemblance to rose-campion. Its stem is usually about 20 inches high; and its flowers are pink-coloured, and bloom from June till September. A very handsome variety of it, with double flowers, and only about a foot high, occurs in bogs, and is worthy of a place in gardens.

CUCKOO-FLOWER (MEADOW), — botanically *Cardamine Pratensis*. A handsomely-flowering, indigenous, perennial-rooted, herbaceous plant, of the lady's-smock genus, and cruciferous order. Its stem is thick, firm, and about a foot high; its radical leaves are winged and spreading; its stem-leaves are small and single; and its flowers grow in little clusters, are large in size, have white and red colours, and bloom in April and May. Two double-flowered varieties, the one with white flowers and the other with red flowers, have long been cultivated in moist shady borders of the flower-garden. The fresh leaves of the meadow cuckoo-flower are sometimes used as spring salads; and, in common with all other edible cruciferæ, have antiscorbutic properties. Expunctions and infusions of the leaves were formerly regarded as efficient medicines in epilepsy, spasmodic affections, and diseases of the urinary organs; but they have lost nearly all their medicinal fame.

CUCUBALUS. See CAMPION.

CUCUMBER, — botanically *Cucumis*. A genus of trailing annual plants, of the gourd tribe. It

is distinguished from other genera of Cucurbitaceæ by the three thick split stigmas of its flowers, and by the thin margin of its seeds. The fruit of all its species is pulpy and many-seeded, and is divided, during its early state, into three or six cells. All the species are exotics, and in some degree tender; and upwards of twenty have been introduced to Britain, while several more have been scientifically described.

Two of the principal species form the topics of our articles COLOCYNTH and MELON.—The citrul, pasteque, or water-melon, *Cucumis citrullus*, was introduced to Britain toward the close of the 16th century. Its stem is usually about two or three yards long; its leaves are deeply cut and gashed into lobes and segments; and its fruit is round, has a spotted rind, and consists of a cold, watery, pinkish or white pulp, containing a number of black seeds. This species, on account of the juiciness and cooling properties of its fruit, is very extensively cultivated in most of the hot countries of the northern hemisphere, whether in Asia, Europe, Africa, or America; but it has not sufficient delicacy of flavour to recommend it for cultivation in the gardens of the cooler parts of the world.

The muricate cucumber, *Cucumis muricatus*, is a native of India, and was introduced to Britain in 1817. Its stem usually attains about two-thirds of the length of that of the citrul; and its fructification has a later habit of maturing. Its fruit is extensively used by the people of India for curries and other dishes.—The dudaim, or apple-shaped cucumber, or Queen Anne's pocket-melon, *Cucumis dudaim*, is a native of the Levant, and was introduced to Britain about the beginning of the 18th century. But though sometimes grown in British gardens, it is regarded as a mere curiosity.—The Jamaica cucumber, *Cucumis jamaicensis*, was introduced to Britain from Jamaica, upwards of 20 years ago, and is a cultivated species.—The acute-angled cucumber, *Cucumis acutangulus*, has an angularly-shaped fruit, and is cultivated in India, but does not seem to have been introduced to Britain. The Hindoos regard it as a favourite and very wholesome pot vegetable, and dress it in various ways.—The tuberous cucumber, *Cucumis tuberosus*, is also cultivated in India, but has not been introduced to Britain. Only the common people among the Hindoos relish it, and they dress it principally in the form of curry.

A species called the most useful, *Cucumis utilisimus*, occurs wild in the higher arable districts of India, and is extensively cultivated by the Hindoos. Its stems are exactly like those of the species commonly cultivated in Britain, but not so extensive; its leaves, in general, are more or less five-lobed; the largest of the lobes are generally about six inches long and six inches broad; and its fruit, when young, is oblong, downy, and clouded with different hues of green, and when ripe, is perfectly oval, very smooth, variegated

with different hues of yellow, and from four to six inches in length, and from three to four inches in breadth. "This," says a scientific observer, "appears to me to be by far the most useful species of cucumis that I know. When little more than one-half grown, the fruits are oblong and a little downy; in this state, they are pickled. When ripe, they are about as large as an ostrich's egg, smooth and yellow; when cut, they have much the flavour of the melon, and will keep for several months, if carefully gathered without being bruised, and hung up; they are also in this state eaten raw, and much used in curries by the natives. The seeds, like those of other cucurbitaceous fruits, contain much farinaceous matter blended with a large portion of mild oil. The natives dry and grind them into a meal, which they employ as an article of diet; they also express a mild oil from them, which they use in food and to burn in their lamps. Experience, as well as analogy, proves these seeds to be highly nourishing, and well deserving of a more extensive culture than is bestowed on them at present. The powder of the toasted seeds, mixed with sugar, is said to be a powerful diuretic, and serviceable in promoting the passage of sand or gravel. As far as my observation and information go, their cultivation is chiefly confined to the Guntoor Circar, where the seeds form a considerable branch of commerce. They are mixed with those of *Holcus Sorghum* or some other of the large culmiferous tribe, and sown together; these plants run on the surface of the earth, and help to shade them from the sun, so that they mutually help each other. The circumstance of the fruit keeping well for several months if carefully gathered and suspended, renders it a very excellent article to carry to sea during long voyages."

The species of cucumber commonly cultivated in Britain, *Cucumis sativus*, was introduced from India in the latter part of the 16th century, but is not known to grow anywhere in a wild condition. It produces its fruit on long trailing and climbing shoots; and is cultivated in frames, under hand-glasses, or in the open ground, according to the season of the year and the temperature of the situation. It is noted for the abundance of the production of its fruit; and though a very tender annual, of but a few months' duration, it easily admits of such succession as shall produce a constant series of fresh fruit throughout the year. Its fruit is eaten in a green or unripe state, both as a salad and as a pickle; and has long been a subject of excessive amateurship with both the gourmand and the gardener. Many varieties of it are in cultivation; and good new ones are from time to time obtained by hybridizing, and published with the same kind of pomp in both name and manner as new varieties of dahlias, calceolarias, and other popular flowering-plants. Some of the chief varieties are the early short green prickly, the early

long green prickly, the most long green prickly, the white Dutch prickly, the early African, the long smooth green Turkey, the long white Turkey, the early green cluster, the large smooth green Roman, the Russian, the Nepaul, the sandy, the large white bonneauil, the black-spined long prickly, the Longford, the snake, the fluted Chinese, and some quite or comparatively recent sorts with such magniloquent designations as 'heroes' and 'victories.' The early short prickly has fruit of about four inches in length, and is the hardiest of all the varieties, and both a rapid grower and a very abundant bearer; and it is very frequently selected for an early crop. The early long prickly produces fruit of about nine inches in length, has hardy habits, and is an abundant bearer, but advances somewhat slowly to maturity; and it is often selected for a main crop. The most long green prickly has fruit of about ten inches in length, and is hardy in habit and a good bearer. The white Dutch prickly has fruit of about six inches in length, and of a peculiar yet agreeable flavour; and it is a rapid bearer. The early green cluster has the characteristics of growing in a compact manner and producing its fruit in clusters, and is, in consequence, well adapted for growth beneath hand-glasses. The Russian excels in the production of the small and finely-pickling kinds of cucumbers commonly called gerkins; and the large white bonneauil, in the production of a fruit well adapted for stewing. The Longford and some of the other varieties are remarkable chiefly for the great size of their fruit; and some of the more recent varieties, 'the victories' and 'the heroes,' profess, if very technically cultivated, to combine great size with very superior flavour. The fruit of the Nepaul is sometimes eight inches in diameter, nearly a foot and a half in length, and about twelve pounds in weight; and the fruit of the snake, though comparatively small in diameter, attains the extraordinary length of several feet.

The cultivation of the cucumber, in a general manner, is understood by every gardener, and, in nicety of detail, is the subject of a vast amount of different and antagonist opinion. Six works, entirely on the cucumber, and written by six different authors, were published during the two or three years preceding 1842; all ordinary books on gardening say quite enough on the subject; and some of the horticultural periodicals, particularly the Gardener's Gazette, contain as many discussions on it as might serve for all the plants of the garden. We shall merely indicate the outline of the general culture, and then quote a brief sentence or two from the treatise of Mr. Allen.—The seed employed should be between two and four years old. Sowings should be made on well-prepared hotbeds from January or February till June; and, on very fine, fresh, friable soil in the open ground, such as the top-spot or a pasture spread out and prepared on a warm border and under the shelter of a hedge, toward

the end of May or in the early part of June. The occasional protection of frames and glasses should be continued beyond the middle of June, over the later spring crops, in order to extend the regular successional supply of fruit throughout the summer. A maximum of heat with protection from the direct play of the sun's rays should be studied in the selection of the border for the open-ground sowings. The influence of cold damp nights and of autumnal strong dews and heavy rains will arrest the growth of the later open-ground crops about the middle of September; and the protection of frames and glasses should then be given to avert the effects of the inclemency of the weather, and a small lining of warm litter should be laid round the outside of the beds to produce the eliminated heat of fermentation. The atmosphere in which cucumbers are grown, whether in a frame, under a hand-glass, or beneath a shading in the open ground, ought to be warm, damp, and free from the evaporating and chemical action of direct sunshine. The play of calorific light upon any plants stimulates the formation of whatever secretions are natural to them, and as the natural secretions of the cucumber fruit are bitter and consolidating, the effect of a play of sunshine upon them while they are growing, is to destroy both their delicacy of flavour and their soft, succulent, grateful fleshiness of texture. Hence the reason why cucumbers grown during the dark and cloudy part of the year are frequently superior to such as are grown in summer.

"When the bed," says Mr. Allen, "is nearly level by the repeated application of fresh mould, and the plants begin to send forth their runners, with your finger and thumb clear them nearly of all false or male blossoms, and rub out every other eye in each runner; those eyes which are left will break out amazingly strong, and grow very fast, their leaves become a tremendous size, and when fruit appears, it will in the first instance be much finer than by any other system. I have very often had them three inches and a half before the blossom is expanded. By the repetition of this mode of culture, as the plants advance in growth, they will never be in so crowded a state as to require the aid of a pruning-knife. * * We all know that cucumbers are not grown to the length of 20 or 30 inches at Christmas time; but in the spring, say April or May, if a brace is required for a particular purpose, they may be obtained with an addition to the treatment before spoken of. I need not state that the plants at this season are very strong, the infant fruit of unusual size, and may be made to travel at an extraordinary pace, as much as two inches in six hours, 14 inches in three days, and to perfection of 27 inches long, in eight days from their being set. * * If any fruit should offer symptoms of being bent, they should be put in the right path in the following manner: when they have been set four days, in the middle of the day, or

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when the heat is at the highest degree, is the best time to perform this operation, as in the morning the fruit will be found quite stiff and brittle; but when the sun has acted upon the plants, and the fruit warmed through, it will, at this age, bend like leather; you may put it into any position you please, or pull it out half an inch occasionally; lay it on a strip of glass, and with three pieces of stick, one at each end of the fruit and one in the middle, with a piece of list between the fruit and the stick to prevent its being marked; it is better than a trough or cylinder, as it is not confined; the colour will remain very green."—*Allen's Treatise on the Cucumber.*—*The Gardener's Gazette.*—*Mawe.*—*Miller.*—*Loudon.*—*Johnson.*—*Museum Rusticum.*—*Penny Cyclopædia.*

CUCUMBER-TREE. See PHILADELPHUS.

CUCUMIS. See CUCUMBER.

CUCURBITA. See GOURD.

CUD. The food which is brought up from the first stomach, rechewed, and sent down to the second stomach, by ruminating animals. Chewing the cud is the popular phrase for rumination. The loss of cud, or ceasing to ruminate, is a symptom of inflammatory diseases and of general debility.

CUDBEAR,—botanically *Lecanora Tartarea*. A species of the cœnothalamous tribe of lichens. The genus *Lecanora*, to which it belongs, comprises about 50 known British species, and between 30 and 40 described species of other countries. Its name signifies a basin, and alludes to the shield-like form of its fructification. Its plants are spreading and crustaceous, and closely adhere to the substances on which they grow; and its apothecia is thick and presses on the crust with a plain convex coloured disc. The cudbear species is about two inches high, and grows at all seasons of the year on greyish rocks. Its crust exhibits a profusion of tartar-like granules; its fructification is scattered; and its disc is flesh-coloured and a little wrinkled. It is extensively employed, particularly in some of the manufactories of Glasgow, for dyeing a purple colour; it was formerly obtained in large quantities from some of the rocky districts of the Scottish Highlands; and it is now extensively imported from Norway. Several other species of *Lecanora*, particularly *L. perellus*, and *L. candelaria*, are also used, though to a far less extent than cudbear, for dyeing.

CUDWEED,—botanically *Gnaphalium Germanicum*. A curious annual weed, of the thistle division of Compositæ. It was called by Linnaeus *Filago Germanica*. It grows in sandy fields of both England and Scotland. Its stem is white, slender, and from 8 to 12 inches high; its herbage is cottony; and its flowers have a yellowish-brown colour, and appear from June till August. It was formerly regarded as medicinal; and it is still sometimes used by the peasantry to lay among linen for preserving them from moths.

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Some other indigenous species of the old, multitudinous genus *gnaphalium* occasionally share the popular name of cudweed.

CULM. The stem of a grass, of a scitamineous plant, or of any other kind of plant which, when cut and dried, yields straw or haulm. A culm is tubular or hollow, and has a series of knots or joints; and at each joint, in most instances, is a single, narrow, long, sharp-pointed leaf.

CULMIFEROUS PLANTS. Plants whose stems are culms. The chief examples of them are the cereal grasses.

CULTIVATION. The working and improving of the soil by tillage, weeding, manuring, and other processes. Its object is to obtain an abnormal development and production of plants, or of parts of plants, used for the purposes of food, industry, or human enjoyment; and the plants with which it deals are called cultivated plants, and contradistinguished by it from wild plants.

CULTIVATOR. Any horse-hoeing implement, but especially the grubber. See the article **GRUBBER**.

CUMIN,—botanically *Cuminum*. A hardy, annual, medicinal plant, of the umbelliferous family. It constitutes a genus of itself, and takes for its specific name *Cuminum*. It is a native of Egypt, and was introduced thence to Britain toward the close of the 16th century. Its stem is slender, round, branching, and frequently procumbent; its leaves are linear, narrow-pointed, and of a deep green colour; its flowers are produced in numerous, four-rayed umbels, have a white colour, and appear in June and July; and its seeds are oblong, striated, and of a pale brown colour, and are produced in twos, which are united to each other on their flat sides. The seeds have a peculiar strong odour, and a warm, bitterish, unpleasant taste; they possess carminative and tonic properties; and they are used in medicine as an external stimulant, and in the arts for flavouring the spirits of the distillery. The plant is extensively cultivated in Malta, Sicily, Holland, Germany, and some other European countries; and it serves the same purposes throughout the north-west of Europe which are served by caraway and coriander in Britain. It requires a rich soil, and is rather late in ripening its seeds; so that it is ill-suited to field husbandry in any part of Britain except some of the best lands in the south of England. In Germany, it is either sown broadcast among spring-corn, or transplanted into rows alternately with cabbages, beet, or parsnip.

CUMIN (BASTARD),—botanically *Lagacia*. A curious, hardy, annual plant, of the umbelliferous family. It abounds in Provence and in some other districts near the Mediterranean; and it was introduced to Britain from the Levant about the middle of the 17th century. Its stem grows about a foot high; its leaves resemble those of honeywort; and its flowers have a greenish-yellow colour, and grow in spherical heads at the extremity of the shoots, and appear in June and July. Its

popular name is rather a misnomer; yet is almost the only thing which recommends it to popular notice.

CUMMINGIA. A genus of superbly-flowering, bulbous-rooted, Chilean plants, of the asphodel tribe. The campanulate species, *C. campanulata*, was introduced to Britain about twenty-three years ago; but is regarded by some botanists as a *Conanthera*. Its leaves are grassy; its stem grows to the height of nine or ten inches; and its flowers have an elegantly bell-shaped form and a beautiful blue colour, and bloom from July till November.—Two very handsome, winter-flowering species, of about the same height of stem and with the same general colour of flower as the preceding, *C. tenella* and *C. trimaculata*, were introduced in 1829.

CUNNINGHAMIA. A very beautiful and nearly hardy, evergreen, ornamental tree, of the coniferous family. It is a native of China, and was introduced to Britain in 1804. It furnishes an awkward instance of the want of proper understanding among botanists in adjusting the nomenclature of their science; for it figures variously as *Pinus lanceolata*, *Belis jaculifolia*, *Auracaria lanceolata*, *Cunninghamia sinensis*, and *Cunninghamia lanceolata*; but it may now be regarded as having chosen the last of these names, and as constituting a genus of itself. Its stem usually attains a height of about 20 feet; its branches, foliage, and general appearance, closely resemble those of the altingia division of the *auracarias*; and its leaves are lanceolate, stiff, and pungent, and, in the mature years of the plant, collect into cones. It closely approaches the Norfolk-Island pine in supereminence of dendritic beauty; and, in spite of much difficulty of propagation and some tenderness of habit, has already found its way into very numerous British collections. It requires a light soil, and succeeds in the open air, not only in the south of England, but in sheltered situations in the vicinity of Edinburgh. The grand difficulty in propagating it is to make it throw up a vigorous leader, or to assume the habit of a tree, from a rooted cutting; but this difficulty can, in every case, be overcome. Its shoots, as soon as it is well established, should be bent into horizontal position, and fastened down with pegs; and if the leading shoot which then arises should, after a year or two, relax its upward growth and become bushy, it also must be bent down and confined with pegs; and by this management a good stem-shoot is certain to be obtained.

CUNONIA. A genus of plants constituting the type of the natural order *Cunoniaceæ*. This order was formerly included in the *Saxifragææ*; and its flowers have the same construction as those of the *Saxifragææ*, but, instead of being loosely arranged, are either racemose or densely spiked. Its leaves are opposite, and, in most instances, pinnated; and the colour of its flowers is either red or white. It consists of trees and

shrubs, and belongs principally to Southern Africa and the warmer parts of South America. The bark of some of its species possesses much tannin and is very astringent. Not more than about a dozen species have been introduced to Britain; and these are distributed among the genera *cunonia*, *callicoma*, *ceratopetalum*, *bauera*, and *weinmannia*. Only one species of the genus *cunonia*, *C. capensis*, is known in the gardens of Britain; and this is an ornamental, evergreen, white-flowering, Cape-of-Good-Hope tree, of naturally about 25 feet in height.

CUPANIA. A genus of beautiful, evergreen, tropical shrubs and trees, of the soap-berry tribe. Seven or eight species have been introduced to the hothouses of Britain, from Mexico and both of the Indies; and about as many more have been scientifically described. The introduced species carry white flowers, and vary in height from two to eight yards.

CUPHEA. A genus of very beautiful exotic plants, of the *salicaria* tribe. Upwards of a dozen species have been introduced to British gardens; and nearly a score of additional species have been botanically described. Five of the introduced species are half-hardy annuals; and most of the others are hothouse, evergreen undershrubs. The flower of each species is very irregular in configuration, and has a spur or protuberance at the posterior base of the calyx; and the seed-vessel is correspondingly curious.—The lance-leaved species, *C. lanceolata*, is a native of Mexico, and was introduced to Britain in 1796, and, after becoming lost, was recently reintroduced. Its root is annual or biennial; its stem is erect, cylindrical, branching, and purple; its leaves are opposite, lanceolate, obtuse, entire, and two inches long; and its flowers are solitary and pedunculate, and have an imposing appearance and a beautiful purple violet colour,—and each has four petals at top like a pansy, and four small ones at bottom. The whole plant is profusely clothed with soft clammy purple hairs, and emits a powerful balsamic odour. It was formerly treated as a stove plant, but it now grows and matures its seeds in the open border.—The very clammy species, *C. viscosissima*, is a purple-flowered annual, of about a foot in height, introduced from America, seventy years ago. The procumbent species, *C. procumbens*, is a pale-purple-flowered annual of about a foot in height, introduced from Mexico in 1816. The silene-like species, *C. silenoides*, is a bluish-flowered annual, of about two feet in height, introduced in 1836.—The hairy species, *C. strigillosa*, is a neat-growing stove plant, introduced in 1844. Its leaves are oval heart-shaped, and of a lively green colour; and its flowers are tubular,—and when grown in a stove are yellowish,—but when grown in a cooler temperature, are vermilion-coloured on the exposed side, and yellow beneath.

CUPRESSUS. See **CYPRESS**.

CURAGUA. See **INDIAN CORN**.

CURB. A disease in the limbs of the horse. It consists in an extension of the ligaments of the hock; it sometimes is partly or perhaps wholly occasioned by the kind of distortion or malformation in the limbs popularly termed "sickle hams;" but it is more frequently caused by violent jerking of the ligaments of the hock, or of the sheath of the tendons passing downward from them, in leaping, rearing, kicking, or sudden and excessive straining. The lameness connected with curb is in some instances considerable, in most somewhat inconsiderable, and in all such as to constitute a greater or less degree of unsoundness. The proper treatment of it is the same as that of other ligamentary extensions.

CURCULIGO. A genus of tender, evergreen, herbaceous, ornamental plants, of the *hypoxis* tribe. The name *curculigo* is formed from a word signifying "a weevil," and alludes to the beetle-like shape of the seeds. The orchis-like species, *C. orchioides*, is a native of India, and was introduced to Britain about 25 years ago. It grows 6 or 8 inches high, and carries a yellow flower in June and July. Its tuberous and wrinkled root has a somewhat bitter and mucilaginous taste; and is prescribed, by the Hindoo physicians, in the form of electuary, for purifying and sweetening the blood. Five or six other species, varying in height from a few inches to upwards of a yard, and all carrying yellow flowers, have been introduced from India and the Cape of Good Hope.

CURCUMA. See **TURMERIC**.

CURD. The coagulum of milk, comprising its caseous ingredients, and constituting the material for cheese. See the article **CHEESE**. Curd, as obtained either by the natural souring of milk, or by the chemical action of rennet, or of an intermixed acid, is a white, insipid, odourless substance, soluble by alkalies, insoluble in water, and convertible by alcohol into a very fetid matter, of the colour and consistency of spermaceti. Nearly the whole of the curd of milk may be completely separated from the whey by means of steady and prolonged heat at the boiling point of milk. "It still," says Dr. Thomson, "retains its sweet taste; but much of the milky flavour is dissipated. If it be now evaporated over the steam-bath, it deposits a number of crystals of sugar of milk. Towards the end of the evaporation, some crystals of chloride of potassium, and some of common salt, make their appearance. According to Scheele, it contains also a little phosphate of lime, which may be precipitated by ammonia. * * The sugar of milk constitutes, at an average, about 3·5 per cent., while the saline ingredients do not exceed 0·22 per cent. of whey. The water, of course, constitutes about 93·3 in the 100 parts." A very good cement for glass and china consists of the viscid residuum of the filtered and evaporated solution of equal parts of curd and alcohol.

CURD-BREAKER. An implement or small hand-machine for breaking and comminuting the curd of skimmed-milk cheeses. It consists principally of a hopper for receiving the curd, a hard-wood cylinder studded with teeth, for cutting the curd, and a winch for turning the cylinder. It is held over a tub, and can be worked by a young boy or girl. It admits of being easily taken down and reconstructed, so as to undergo frequent internal washing.

CURL. A disease in potato plants. It is developed before the plants rise to the surface of the ground; and it affects them through all the future stages of their existence. The stem of the infected plants is puny and stunted; the leaves are meagre, sickly, and crumpled; and the tubers are small, and, if used for sets, are certain to propagate the disease. Curl takes its name from the crumpled appearance of the leaves of infected plants; and is readily recognised by every potato-grower in districts which it has at any time infested. It has often proved very devastative to potato-crops throughout entire districts of good land, in excellent cultivation; and it has rarely or never appeared in some other districts whose poor condition might have seemed to predispose the soil to its attack.

Curl has been the topic of much ingenious speculation, and has been ascribed, by even acute and wise observers, to a great diversity of causes. Some writers ascribe it to the preying of insects upon the sets and the young stems; others, to excessive seed-bearing; others, to planting at either too small or too great depths; others, to the influence of a late, frosty, and otherwise ungenial spring; others, to too early planting; others, to too small cuttings; others, to an over-ripening of the tubers used for sets; others, to the oldness and dryness of the sets; others, to the exhaustion of the vital energy of the sets by the sprouting of the tubers from which they are formed; and others, to some local and hereditary but inexplicable influence. Of all these causes, the true one appears to us to be the diminution of the vital energy of the tubers either by over-ripening, by bad-keeping, by sprouting, or by too deep planting. The want of strength to develop a full healthy plant, is the disease itself in embryo; and this is occasioned by any circumstance which diminishes the store of nourishment contained in the tubers for the support of the young plants. See the article **BULB**.

"No disease," says Mr. George W. Johnson, "appears to me so evidently to arise from impaired vital energy in the plant as the curl. Any one can insure the occurrence of this disease, at least I have found so in the county of Essex, by keeping the sets in a situation favourable to their vegetation, as in a warm damp outhouse, and then rubbing off repeatedly the long shoots they have thrown out. Sets that have been so treated, I have invariably found produce curled plants.

Is not the reason very apparent? The vital energy had been weakened by the repeated efforts to vegetate; so that, when planted in the soil, their energy was unequal to the perfect development of the parts; for the curl is nothing more or less than a distorted or incomplete formation of the foliage, preceded by an imperfect production of the fibrous roots." He then details an experiment which both clearly illustrates and strongly confirms his views; and adds, "Dickson, Crichton, Knight, and others have found that tubers, taken up before they are fully ripened, produce plants not so liable to the curl as those that have remained in the ground until completely perfected; and I believe, under ordinary treatment, this to be the fact, for it is rational. The process of ripening proceeds in the potato, as in the apple, after it has been gathered; and until that is perfected, it is accumulating vigour, shows no appetency to vegetate, consequently is not exhausting its vitality,—which is a great point, considering the careless mode usually adopted to store them through the winter,—for this energy commences its decline from the moment it begins to develop the parts of the future plant. Tubers taken from the soil before perfectly ripe, never are so early in showing symptoms of vegetation. Crichton, Hunter, and Young have also agreed, that exposing the sets to light and air, allowing them to become dry and shrivelled, also induces the curl in the plants arising from them. This result of experience also confirms my conclusion, that the disease arises from deficient vital energy; for no process, more than this drying one of exposure to the light and air, tends to take away from a tuber altogether the power of vegetating."

The means of preventing curl are distinctly suggested by the nature of its cause; and some of these means will, at the same time, prevent other diseases of the potato, and promote the general health and vigour of the plants. Tubers intended for sets ought to be simply matured and not over-ripened; they ought to be kept, throughout the winter and till the time when they are wanted, in a condition of dryness, coolness, and exclusion from light and air; and if, through mismanagement or accident, they be allowed to shoot, or even to exhibit decided symptoms of begun vegetation, they ought to be rejected from the uses of planting. The sets ought to be planted immediately after they are cut; and ought to be kept from exposure, during even the briefest time, to the play of sunshine, to a very high temperature, or to the current of a drying wind. The manure ought to be regularly spread, and mixed with the soil, and not laid along a trench, or put in immediate contact with the sets. Potatoes ought not to be planted, for a succession of years, on the same field or plot; and the tubers used for planting ought, every year, or as frequently as possible, to be obtained from another kind of soil, particularly from a poorer one, than that in

which they are to be planted. "I have observed," says Mr. Crichton, "wherever the seed-stock is carefully pitted, and not exposed to the air, in the spring the crop has seldom any curl; but where the seed-stock is put into barns and outhouses for months together, such crop seldom escapes turning out in a great measure curled; and if but few curl the first year, if they are planted again, it is more than probable the half of them will curl next season." "Generally," says another writer, "at the root end of the potato, or what some call the waxy end, almost close by the feeding-string, there is an eye, which, cut by itself, mostly produces a curl, unless it has another eye in the cut or set, which other eye generally springs first, and stops the former from growing; except in the foresaid cut, I recommend only one eye. By attention to this, this season I could show a whole break, and scarcely a curl in the whole break; they were early potatoes, which are more given to curl than the late sorts."—*Memoirs of the Caledonian Horticultural Society*.—*The Gardener's Gazette*.—*Quarterly Journal of Agriculture*, Nos. 17, 38, and 42.—*Stephens' Book of the Farm*.

CURLEW. A genus of birds belonging to the order *Grallæ*, or waders, and family *Limicolæ*, whose most remarkable characteristic is, that the bill is wholly or partially covered by a soft, sensitive skin, which enables them to obtain their food from the mud with facility, though unable to discover it by sight. The genus is characterized by a very long, slender, almost cylindrical, compressed and arcuated bill, having the upper mandible longer than the lower, furrowed for three-fourths of its length, and dilated and rounded towards the tip. The nostrils are situated in the furrow, at the base, and are lateral, longitudinal, and oblong. The tongue is very short and acute. The feet are rather long, slender, and four-toed; the tarsus is one half longer than the middle toe. The fore-toes are connected, at the base, by a short membrane, to the first joint. The nails are compressed, curved, acute, and the cutting edge of the middle one is entire. The first primary is the longest; the tail, which is somewhat rounded, consists of 12 feathers. The plumage of the curlew is generally dull, being greyish-brown, rusty-white, and blackish, in both sexes, which are similar in size. The young bird also differs very little from the parents, except that the bill is much shorter and straighter. Their favourite resorts are marshy and muddy places, in the vicinity of water, over which they run with great quickness. They feed on various worms, small fishes, insects and molluscous animals, and are very shy, wary, and vigilant of the approach of man. They are monogamous, and pass most of their time separate from the rest of their species. Their nests are built on tufts or tussocks in the marshes, and, during incubation, both parents assiduously devote themselves to their charge. The eggs are

usually four, being much larger at one end than the other, or pyriform in shape. The young, as soon as hatched, leave the nest to seek their own subsistence. At the period of migration, the curlews unite to form large flocks, and their flight is high, rapid, and protracted. They utter a loud, whistling note, easily recognised when once heard, but not easy to be characterized by description.

CURRENTS. Red currants and black currants are the fruit of well-known shrubs, which are cultivated in gardens, and which also grow wild, in woods or thickets, in various parts of Europe and America. The utility of all these fruits in domestic economy has long been established. The juice of the red species, if boiled with an equal weight of loaf-sugar, forms an agreeable substance, called currant jelly, which is much employed in sauces and for other culinary purposes, and also in the cure of sore throats and colds. The French frequently mix it with sugar and water, and thus form an agreeable beverage. The juice of currants is a valuable remedy in obstructions of the bowels; and, in febrile complaints, it is useful, on account of its readily quenching thirst, and for its cooling effect on the stomach. This juice, fermented with a proper quantity of sugar, becomes a palatable wine, which is much improved by keeping, and which, with care, may be kept for twenty years. The inner bark of all the species, boiled with water, is a popular remedy in jaundice, and, by some medical men, has been administered in dropsical complaints. White and flesh-coloured currants have, in every respect, the same qualities as the red species. The berries of the black currant are larger than those of the red, and, in some parts of Siberia, are even said to attain the size of a hazel-nut. They are occasionally made into wine, jelly, or syrup. The two latter are frequently employed in the cure of sore throats. The leaves are fragrant, and have been recommended for their medicinal virtues. An infusion of them in the manner of tea is very grateful, and, by many persons, is preferred to tea. The tender leaves tinge common spirits so as to resemble brandy; and an infusion of the young roots is useful in fevers of the eruptive kind. The dried currants of the shops do not belong to this family, but are a small kind of grape.

CURRY-COMB. A small, hand instrument, made of iron, full of small teeth, and used for grooming horses.

CURRYING. The art of dressing cow-hides, calves'-skins, seal-skins, &c., principally for shoes; and this is done either upon the flesh or the grain. In dressing leather for shoes upon the flesh, the first operation is soaking the leather in water until it is thoroughly wet; then the flesh side is shaved on a beam about seven or eight inches broad, with a knife of a peculiar construction, to a proper substance, according to the custom of the country and the uses to which it is to

be applied. This is one of the most curious and laborious operations in the whole business of currying. The knife used for this purpose is of a rectangular form, with two handles, one at each end, and a double edge. After the leather is properly shaved, it is thrown into the water again, and scoured upon a board or stone commonly appropriated to that use. Scouring is performed by rubbing the grain or hair side with a piece of pumice stone, or with some other stone of a good grit. These stones force out of the leather a white substance, called *the bloom*, produced by the oak bark in tanning. The hide or skin is then conveyed to the shade or drying place, where the oily substances are applied, termed *stuffing* or *dubbing*. When it is thoroughly dry, an instrument, with teeth on the under side, called a *graining-board*, is first applied to the flesh-side, which is called *graining*; then to the grain-side, called *bruising*. The whole of this operation is intended to soften the leather to which it is applied. Whitening, or paring, succeeds, which is performed with a fine edge to the knife already described, and used in taking off the grease from the flesh. It is then boarded up, or grained again, by applying the graining-board first to the grain, and then to the flesh. It is now fit for waxing, which is performed first by colouring. This is effected by rubbing, with a brush dipped in a composition of oil and lamp-black, on the flesh, till it be thoroughly black: it is then sized, called *black-sizing*, with a brush or sponge, dried and tallowed; and, when dry, this sort of leather, called *waxed*, or *black on the flesh*, is curried. The currying leather on the hair or grain side, called *black on the grain*, is the same with currying on the flesh, until we come to the operation of scouring. Then the first black is applied to it while wet; which black is a solution of the sulphate of iron called *copperas*, in fair water, or in the water in which the skins, as they come from the tanner, have been soaked. This is first put upon the grain after it has been rubbed with a stone; then rubbed over with a brush dipped in stale urine; the skin is then stuffed, and, when dry, it is seasoned, that is, rubbed over with a brush dipped in copperas water, on the grain, till it is perfectly black. After this, the grain is raised with a fine graining-board. When it is thoroughly dry, it is whitened, bruised again, and grained in two or three different ways, and, when oiled upon the grain, with a mixture of oil and tallow, it is finished.

CURSONS. Spurs on the stems and branches of apple-trees, currant-bushes, and other fruiting ligneous plants.

CURTISIA. An evergreen, Cape-of-Good-Hope, timber tree, of the staff-tree tribe. It forms a genus of itself, and takes for its specific name *Faginea*; and this name alludes to the resemblance of its leaves to those of the beech. It is known among the English population of the Cape

of Good Hope as the Hassagay-tree. Its usual height is about 30 or 35 feet. It was introduced to Britain about the middle of the latter half of last century.

CUSCUTA. See DODDER.

CUSTARD-APPLE. See ANNONA.

CUSTOMS OF COUNTIES. See LEASE.

CUT. A clean wound, inflicted with any sharp instrument. The lips or edges of a cut in a horse or in any other large animal ought to be placed together by means of tow, ligaments, strips of plaster, or other appliances, but ought not to be dressed with balsams or ointments. The whole art of healing a cut or clean wound is to exclude the air from it, and allow it to be undisturbedly dealt with by the mere organism of the system.

CUTANEOUS DISEASES. Diseases of the skin of animals. The chief of these which attack the animals of the farm will be found noticed in the articles SCAB, MANGE, SURFEIT, HIDE-BOUND, and WARTS. See also the articles CUTICLE and SKIN.

CUTICLE. The epidermis of plants and animals. The cuticle of plants will be noticed in the article EPIDERMIS. The cuticle of animals is the outer one of the three layers which constitute their skin, and is sometimes popularly designated the scarf-skin. It serves as a firm insensible covering, not only of the whole body, but of the immediately subjacent layers of the rete mucosum or web-like mucilaginous suffusion, and of the dermis, cutis, or highly organized membrane of the true skin. It consists of myriads of thin, transparent, microscopic scales, somewhat like those of fish; it is attached to the dermis by means of papillæ which run into its substance; and it is separable from the dermis by means of blistering in the living subject, and of maceration and boiling in the dead body. Its thickness is very different in different parts of the body; and is capable, in any one part, of being greatly increased by frequent friction or abrasion.

CUTTING. A horse's wounding the inside of his fetlock-joint when travelling. The most frequent cause of it is the inclined position of the toe either inward or outward of a straight line to the point of the shoulder. When the toe inclines outward, the inner quarter of the hoof is generally lower than the outer quarter; so that, in order to give the foot a proper position, and to prevent cutting, the outer quarter of the hoof should be lowered, or the outer branch of the shoe made thinner than the inner branch. When the toe inclines inward, cutting takes place on the inside of the knee, at the lower part of the joint; and this is technically called the speedy cut, from its happening upon the trot or the gallop, and is considered a dangerous unsoundness, from its sometimes giving so sudden and violent a blow as to bring the animal instantly to the ground. The remedies for this are to keep the toe as short as possible, and to alter the improper

position of the foot. Whenever cutting is observed, the precise part of the hoof or shoe which occasions it should be promptly and carefully ascertained; and this ought to be rasped away as much as can be done with safety, and, if necessary, put out of its noxious position by altering the inclinations of the foot in shoeing. Cutting is frequently occasioned by mere fatigue or weakness, and, in consequence, often afflicts young horses which are ridden hard over deep heavy ground; and when any risk of it occurs from this cause, the exposed part ought to be protected with leather or a boot, or, what is far better, the animals ought to be allowed rest, ease, and recruitment.

CUTTING. A detached part of a twig, branch, or shoot of a plant, used for producing a new individual. A piece of willow or of poplar, stuck into the ground, strikes root, forms branches, and becomes a tree; and pieces of great multitudes of other plants, including many hundreds of the shiest and most delicate in our gardens, are commonly used in the same way, for propagating their respective species. The probability is, too, that if due attention were paid to soil, temperature, moisture, age of cutting, season of using it, and other circumstances, all plants whatever, which form buds, could be propagated from cuttings. The age at which a cutting of any one species will strike best or strike at all is matter of experiment; but it seems to be invariable or to require only befitting circumstances, so that a single ascertaining of it becomes a portion of the common stock of horticultural knowledge. The proper age and circumstances for any untried species, also, may be proximately estimated from those of the most nearly related or most nearly analogous tried species; and so accurately can estimates be made, that some experimental gardeners propagate from cuttings of newly-discovered and delicate plants almost as successfully as from cuttings of indigenous and coarse ones, and appear to the uninitiated or to bunglers almost as if wielding a magical or thaumaturgic influence. Every cutting is merely a group of two or more buds or "eyes," continuing attached to a portion of cortical and woody texture; it possesses, in the buds, those embryos of enlargement and fructification, which become developed upon a parent stock by natural growth, and upon a foreign stock by means of the artificial process of budding; it possesses, in its portions of cortical and woody texture, a natural and living organization for taking up liquid nourishment to the buds, to sustain and feed them during their progress of expansion; and it may possess, also, in an attached leaf or two on its upper part, a natural and living organization for elaborating the rising sap, imbuing it with carbon from the atmosphere, and sending it down, in the character of cambium, to stimulate and feed the formation and growth of roots. But a full and minute view of the physiological principles on which a cutting

becomes a plant, may be obtained by reference to our articles **ABSORPTION**, **BUD**, and **BUDDING**.

An ordinary cutting contains two buds, the one near its lower end, to serve as the rudiment of roots, and the other near its upper end, to serve as the rudiment of stem and branches. But whether it contain only two buds or a greater number, it is inserted in the soil quite to the vicinity of its uppermost bud; so that only one bud may be exposed to the stimulating power of light and air, and that the largest possible proportion of the surface may be immersed in moisture and darkness, and may there be facilitated in the formation of roots. When a cutting has considerable difficulty in striking, it is covered with a bell-glass, in order that it may be surrounded with a constantly moist atmosphere, and may be protected from the exhaustion of excessive evaporation; and when it has eminent difficulty in striking, it is set either in pure silex, technically called silver sand, or with its lower extremity resting on the bottom of the pan or flower-pot in which it is placed, in order that it may be protected from gorging and internal stagnation by a too plentiful absorption of crude sap. In many instances, an entire leaf or a part of a leaf is left attached to the upper extremity of the cutting, in order that it may elaborate the ascending sap, and perform from the outset some of the functions of a perfect plant.

Mr. Niven, the curator of the Dublin Botanic Garden, says, in a paper which was read to the British Association at Liverpool in 1837, "There appear, exterior to the wood itself," or duramen, "two perfectly distinct principles; the one passing upwards from the roots to the development of leaves, which I would call the leaf principle, for I find it cannot be changed; and the other passing downwards from the leaves to the development of roots, which I would call the root principle, and which also appears to be equally permanent. A very satisfactory proof of this is found in the case of propagating plants from cuttings. Each cutting appears to contain within itself so much of the two principles, that it only requires to be placed under such circumstances of atmosphere as will tend to preserve the action of the leaves without collapsing, until the descending principle has had time to ramify itself, through their action, into roots; when, by a gradual removal of the bell-glass, the plant is prepared to perform its various functions unaided, as well as to meet the vicissitudes of a constantly changing atmosphere. The one principle, I have no doubt, will be found to proceed principally from the soil to the expansion of leaves, and the other from the combined agency of the atmosphere to the formation of new wood and roots and the extension of the roots." Mr. Niven's doctrine has been contested; yet it is worthy of grave consideration and of experimental testing; and, in so far as it is true, it shows the propriety, or rather the necessity, of having as much leaf

or leaves on the upper extremity of every cutting as can, with the aid of the moisture within a bell-glass, be kept from collapsing.

Cuttings, not only of woody plants, but of many herbaceous ones, are capable of being struck in water. The process for striking a cutting of *Nerium oleander* in water has long been known; and, though different in some of its phenomena from the processes for some other plants in water, will sufficiently illustrate the principles and the general manner of all. The vessel for the cutting should be a phial of white glass, with a neck of at least three quarters of an inch in width, so as to permit the removal of the young plant without much pressure on its newly-formed roots; the cutting ought to be of green wood, and taken off at some time of the full growing season of spring and summer; and the water should always be sufficient in quantity to immerse an inch or more of the lower part of the cutting, and should be maintained at a temperature of about 70° Fahrenheit, either by being kept in a warm room exposed to the sun's rays, or by being plunged into a warm bed of leaves, tan, or other calorific mass of slowly fermenting vegetable matter. No manurial ingredient, not even so much as a little moss, should be introduced to the water; and the young plant should be withdrawn from the phial, and planted in soil as soon as its roots are fairly formed. Cuttings of balsams, whether small or large, freely strike root in water. Cuttings of melons will strike in water in a very short period,—sometimes so short as three days; and when the plantlets of them are transferred to small pots of heath mould, they produce perfect balls of roots in less than a week. Cuttings of gloxinias, heliotropes, aloysias, gardenias, melastomas, thunbergias, salvias, erythrinæ, gesnerias, turneras, and many other greenhouse plants, have all been found on experiment to strike readily in water; cuttings of dahlias have been successfully tried; and probably the cuttings of an exceedingly great number of plants would succeed. Cuttings struck in soil undergo their changes, either of success or of failure, in the dark, so that they cannot be observed for the purposes of either economy or soil; and sometimes, after exciting hopes for months, they damp off and perish. But cuttings placed in water are clearly and instructively observable through all the progress of either their decay or their development; they require no nicety, give no trouble, and consume but a minute or so of time in being adjusted to their position; and when they succeed at all, they never droop, but grow surely and steadily into complete development.

CUTTING-BOX. A machine for cutting hay, straw, haulm, or other kinds of fodder, into small pieces. See **CHAFF-CUTTER**.

CYCAS. A genus of curious, economical, sago-yielding, tropical plants, constituting, with the genus *zamia*, the natural order Cycadæ or Cycadaceæ. The plants of this order have a low, cylin-

drical, unbranched trunk, of a structure and character partly exogenous and partly acrogenous, and they possess the general appearance of palms, the foliage of tree-ferns, the inflorescence of gigantic equisetums, and the fructification of some kinds of cone-bearing trees. Their stems contain concentric layers in the manner of exogens, and at the same time secrete a voluminous farinaceous pith in the manner of palmaceous endogens; their leaves unroll from a single terminal bud in the manner of acrogens; and their fruit proceeds from their leaves in the manner of ferns, and has a peltately-scaly conical structure, in the manner of true conifers. All are dioecious; and those of the *cycas* genus are distinguished from those of the *zamia* genus by the botanical characters of the female flowers. Nearly thirty species have been introduced to the hothouses of Britain; and at least five of these belong to the genus *Cycas*.

The revolute species, *Cycas revoluta*, was brought to Britain from China about 110 years ago; and has, within the last twenty years, been in several instances brought to flower. A plant of it which flowered in 1837 was purchased for the Royal Society of Horticulture at the price of fifty guineas, and exhibited for a short period at the Egyptian Hall. Another plant of it which flowered in 1828, at Cally in Kirkcudbrightshire, and which probably was the first that ever flowered in Britain, is supposed to have been upwards of 40 years old. Its stem was 18 inches high and 30 inches in circumference; its fan of leaves comprised 36 long feathery-looking fronds, and 27 feet in circumference; and its catkin rose vertically from the apex of the stem, measured 34 inches in height and 15 inches in maximum circumference, and was set round, in a regularly imbricated manner, with about 1,500 scales. All the species, but particularly *C. revoluta* and *C. circinalis*, the latter introduced to Britain from India in 1700, produce from their pith a coarse kind of sago, and are frequently, though quite improperly, designated sago palms.

CYCLAMEN. A genus of tuberous and bulbous-rooted beautifully-flowering plants, of the primrose tribe. The ivy-leaved species, *C. hederifolium*, is a native of Italy, Austria, and other parts of continental Europe, and now grows wild on banks and by the side of hedges in some parts of Britain. Its root is orbicular, compressed, and comparatively large; its flowers rise immediately from the root, with long fleshy footstalks, and have a purple colour, and appear in August and September; its leaves are numerous and angularly cordate, marked with black in the middle, and about 6 or 7 inches long, and they rise immediately from the root, begin to appear soon after the evolution of the flowers, continue to grow during all the winter and the spring, and begin to decay in May, and are entirely dried up in June; and after the flowers have fallen, the footstalks twist up like a screw, enclosing the germen in the centre, lying close to the ground

among the leaves, and there protecting the germs till it becomes ripe at the time of the final decay of the leaves. A variety of this species has white-coloured flowers. Nine other species, *europæum*, *vernum*, *coum*, *repandum*, *persicum*, *latifolium*, *neapolitanum*, *linearifolium*, and *ibericum*, are cultivated in gardens; but all have a height and habits similar to the ivy-leaved species and the crocuses; and they differ from one another principally in the form and appearance of the leaf, and in the colour and fragrance of the flower. The most common are *coum* and *europæum*; and the most beautiful, or at least the most diversified, is *persicum*. *Cyclamens* deserve a prominent place in every garden which has warm borders or the convenience of frames; for not only are they handsome in themselves, but they afford a constant succession of bloom, and enliven the winter as profusely as the spring or the summer. *C. vernum* begins to bloom in November, and *C. coum* about the end of December; and both of these continue in flower during several months. *C. persicum*, comprising five very distinct varieties, can be made to bloom from October till June; *C. europæum* comes into flower in the latter part of June; and *C. hederæfolium* fills up the interval between the last and *C. vernum*. The seeds of all the species require to be sown as soon as they are ripe. The root of *C. europæum* is the principal food of the wild boars of Sicily, and hence is popularly called sow-bread. Great acridity exists in both the root and the leaves of *C. europæum*; and a considerable degree of the same property resides in some of the other species.

CYCLOBOTHR. A genus of very beautiful, tuberous-rooted plants, of the tulip tribe. It was constituted by Mr. Sweet out of the purple and the bearded species of fritillary; and it now includes the plant which was formerly called *Calochortus elegans*, and two recently discovered Californian plants, the one white-flowered and the other yellow-flowered, and both about a foot high. It partakes the splendours of both *Calochortus* and *Fritillaria*. Its name signifies 'a circular pit,' and alludes to a nectar-holding hollow in each petal of its flowers.

CYCLOID. The line described by a moving wheel. Imagine a circle which is rolled perpendicularly along a straight line, till the point first at rest is brought to rest again, after an entire revolution. The curve, thus described by this point, is called a *cycloid*, because every point in the circumference of a revolving wheel describes a similar curve. The circle is called the *generating circle*; the line on which it is described, the *base of the cycloid*. The length of the cycloid is always four times the diameter of the generating circle, and its area three times the area of this circle. This line is very important in the higher branches of mechanics.

CYCNOCHES. A genus of ornamental, epiphytous plants, of the orchis tribe. *Loddiges'*

species, *C. Loddigesii*, was introduced to Britain from Surinam in 1830; and is one of the most remarkable of the very interesting orchidaceous group. Its pseudo-bulb is elongated, cylindrical, from 8 to 12 inches long, ashy grey, clustered, articulated, sheathed with the bases of former years' leaves, and terminating with a leafy crown; its leaves are sharply lanceolate, membranaceous and striated; and its scape rises from near the top of the pseudo-bulb, and bears many large, imposing, and singularly-shaped flowers. The two lateral sepals are sharply-lanceolate, and have a greenish colour, with transverse brown blotches; the lateral petals are larger, spotless, falcate, and decurved; the lip is lanceolate, thick, and fleshy, and, in the rarest variety, has an ivory-white colour, tipped with green; the claw is spotted with red; and the column is deep purple, remarkably long and slender, gracefully curved in the manner of a swan's neck, and suggesting, by this last character, the name *Cycnoches*, which signifies 'a swan's neck,' and has been popularly translated 'swanwort.' The flower has the additional recommendation of being very fragrant. Two other species were introduced previous to 1840.

CYDER. A liquor made from the juice of apples. The quality of this popular beverage depends principally on the following particulars, viz,—1. kind of fruit; 2. condition of the fruit when ground; 3. manner of grinding and pressing; 4. method of conducting the requisite fermentation, and precautions to be taken against its excess.

1. The characteristics of a good cyder-apple are, a red skin, yellow and often tough and fibrous pulp, astringency, dryness, and ripeness at the cyder-making season. Mr. Knight asserts, that, "when the rind and pulp are green, the cyder will always be thin, weak, and colourless; and when these are deeply tinged with yellow, it will, however manufactured, or in whatever soil the fruit may have grown, almost always possess colour and either strength, or richness." It is observed by Crocker, in his tract on 'The Art of making and managing Cyder,' that the most certain indications of the ripeness of apples are the fragrance of their smell, and their spontaneously dropping from the trees. When they are in this state of maturity, in a dry day, the limbs may, he says, be slightly shaken, and partly disburthened of their golden store; thus taking such apples only as are ripe, and leaving the unripe longer on the trees, that they may also acquire a due degree of maturity. Mr. Buel observes, that "the only artificial criterion employed to ascertain the quality of an apple for cyder, is the specific gravity of its must, or unfermented juice; or the weight compared with that of water. This, says Knight, indicates, with very considerable accuracy, the strength of the future cyder. Its weight and consequent value are supposed to be increased in the ratio of the

increase of saccharine matter." Mr. Knight says that the strongest and most highly-flavoured cyder which has been obtained from the apple, was produced from fruit growing on a shallow loam, on a limestone basis. All the writers on the subject seem to agree that calcareous earth should form a component part of the soil of a cyder-orchard. Coxe says the soil which yields good wheat and clover is best for a cyder-orchard. Mr. Buel states, "My own observation would induce me also to prefer a dry and somewhat loose soil, in which the roots destined to furnish food for the tree and fruit may penetrate freely, and range extensively in search of nutriment."

2. *Condition of the fruit.*—Fruit should be used when it has attained full maturity, and before it begins to decay. The indications of ripeness we have above stated. Each kind of apple should be manufactured separately, or, at least, those kinds only should be mixed which ripen about the same time. Mr. Buel says, "The apples should ripen on the tree, be gathered when dry, in a cleanly manner, spread in an airy, covered situation, if practicable, for a time, to induce an evaporation of aqueous matter, which will increase the strength and flavour of the liquor, and be separated from rotten fruit, and every kind of filth, before they are ground."

3. *Grinding, &c.*—The apples should be reduced, by the mill, as nearly as possible to a uniform mass, in which the rind and seeds are scarcely discoverable, and the pomace should be exposed to the air. Knight ascertained, by experiments, that, by exposing the reduced pulp to the operation of the atmosphere for a few hours, the specific gravity of the juice increased from 1,064 to 1,078; and, from the experiment being repeated in a closed vessel with atmospheric air, he ascertained the accession to be oxygen, which, according to Lavoisier, constitutes 64 per cent. of sugar. For fine cyder, he recommends that the fruit be ground and pressed imperfectly, and that the pulp be then exposed 24 hours to the air, being spread and once or twice turned, to facilitate the absorption of oxygen; that it be then ground again, and the expressed juice be added to it before it is again pressed. A grater cyder-mill was presented by J. R. Newell, of Boston, at an exhibition of the Massachusetts agricultural society, in the autumn of 1828. It is thus described:—"It has a wooden cylinder, upon the surface of which nails are fixed: the heads are sharp upon the edges, and project above the cylinder about one-eighth of an inch. The apples are filled into a hopper placed over the cylinder, and led into a narrow cavity at the upper side of it. The cylinder is mounted on a high frame, its axes being placed in composition boxes. A rapid revolution is produced by connecting it with a horse-mill by belts or bands. The apples are reduced to a fine pomace, grated, not pressed. It performed well in the presence

of the committee, and grated a barrel of russet apples in 1 minute 34 seconds."

4. *Fermentation.*—The vinous fermentation commences and terminates at different periods, according to the condition and quality of the fruit, and the state of the weather. According to Knight, the best criterion to judge of the proper moment to rack off (or draw the liquor from the scum and sediment), will be the brightness of the liquor which takes place after the discharge of fixed air has ceased, and a thick crust is collected on the surface. The clear liquor should then be drawn off into another cask. If it remains bright and quiet, nothing more need be done to it till the succeeding spring; but if a scum collects on the surface, it must immediately be racked off again, as this would produce bad effects if suffered to sink.—Among the precautions used to prevent excessive fermentation is *stunning*, which is fuming the cask with burning sulphur. This is done by burning a rag impregnated with sulphur in the cask in which the liquor is to be decanted, after it has been partly filled, and rolling it, so as to incorporate the liquor with the gas. A bottle of French brandy, or half a gallon of cyder-brand, added to a barrel, is likewise recommended, to be added as soon as the vinous fermentation is completed.

CYDONIA. See QUINCE.

CYLINDER. The name of a geometrical solid, formed by two parallel circular surfaces, called the superior base and the inferior base, and a convex surface terminated by them. There is a distinction between rectangular cylinders and oblique cylinders. In the first case, the axis, that is, the straight line joining the centre of the two opposite bases, must be perpendicular; in the second, the axis must form an angle with the inferior base. The solidity of a cylinder is equal to the product of the base by the altitude. Archimedes found that the solidity of a sphere inscribed in an equilateral cylinder, that is, of a sphere whose diameter is equal to the height, and also to the diameter of the base of the cylinder, is equal to two-thirds of the solidity of the cylinder. The cylinder is one of those figures which are constantly in use for the most various purposes.

CYMBIDIUM. A genus of tropical, epiphytous, ornamental plants, of the orchis tribe. About sixty species are known to botanists; and nine or ten of these have been introduced to the hot-houses of Britain. Two of the introduced species, *C. ensifolium* and *C. sinense*, have fragrant, brown-coloured flowers, closely resemble each other, and have been cultivated in Britain since before the close of last century. The xiphium-leaved species, *C. xiphiifolium*, nearly resembles these, but has spotless, pallid, greenish flowers. The lance-leaved species possesses much beauty. The introduced species vary in height from half a foot to about a yard. The generic name

alludes to the boat-shaped form of the labelum.

CYMBOPOGON. A small genus of grasses, of the arundinaceous division. The lemon-grass species, *Cymbopogon schænanthus*, called by Linnaeus *Andropogon schænanthus*, was introduced to Britain from India about 60 years ago. It is perennial-rooted, grows to the height of 24 or 30 inches, and has a fragrant smell and an aromatic taste. It is popularly known in India as the spice-grass; an infusion of its toasted seeds is there given to children, to assist digestion; and the grass itself is sometimes used as a material for thatching. Five or six other species have been botanically described.

CYMINUM. See CUMIN.

CYNANCHUM. A genus of ornamental plants, of the swallow-wort order. The acute-leaved species, *C. acutum*, is a native of the south of Europe, and was introduced to Britain toward the close of the 16th century. Its root is strong, creeping, and perennial, and spreads to a considerable distance; its stems are herbaceous, twist about everything near them, rise to the height of from 3 to 6 feet, and die to the ground in autumn; its leaves are smooth, pointed, and oblong heart-shaped, and grow oppositely, by pairs, on long footstalks; and its flowers are produced in small bunches from the wings of the leaves, have a dirty white colour, and appear in June and July.—The round-leaved or Montpellier species, *C. monspeliacum*, was introduced to Britain from the south of Europe about the same time as the preceding species; and it closely resembles that species in height, habit, florification, and other characters, but differs from it in having broad, reniform, roundish leaves. Both of these species are exceedingly hardy, and will grow in almost any soil or situation, and will overrun any small plants which are near them; and, on being wounded, they emit a milky juice. They are readily propagated by autumnal division of the root, and require no care.—The extended species, *C. extensum*, called by some botanists *Damia extensa*, is a native of India, and was introduced to Britain about 70 years ago. It is an evergreen ligneous twiner of about 4 feet in height, and carries white flowers in July and August. Its leaves have a disagreeable smell and a somewhat nauseous taste; and the juice of them is both emetic and aperient, and is used in India as a remedy for jaundice.—The twiggy species, *C. viminalis*, called by some botanists *Sarcostemma viminalis*, is also a native of India, and an evergreen ligneous twiner, and was introduced to Britain about 115 years ago. It attains about twice the height of the extended species. Its young shoots and tender stems are eaten by the Hindoos.—Upwards of 20 other species have been introduced to Britain, nearly one half of them hardy and herbaceous, and most of the others tropical, ligneous, evergreen twiners; and nearly 30 additional species have been bo-

tanically described. Some of the introduced species have been popularly designated dog's-bane and Montpellier scammony; and their noxious power over dogs is alluded to in the name *Cynanchum*, which signifies 'dog-strangler.'

CYNAPIUM. See FOOL'S PARSLEY.

CYNARA. See ARTICHOKE and CARDOON.

CYNODON. A genus of grasses, of the subterminally spiked division. The dactylon species, *C. dactylon*, is an indigenous, perennial-rooted, creeping weed, of about a foot in height; but is rare in England, and does not occur in Scotland. A variety of this species, called Indian doob-grass, *C. d. Indica*, has been proposed for cultivation as an agricultural grass; but it is annual in habit, and does not attain the height of the normal plant. Four annual species of little interest have been introduced from India, St. Helena, and North America; and five or six other species are known to botanists. The name *cynodon* signifies 'dog's-tooth.'

CYNOGLOSSUM. See HOUND'S-TONGUE.

CYNOSURUS,—popularly *Dog's-Tail Grass*. A genus of grasses, of the division with many-flowered panicles. Their panicles are spiked; their spikelets contain four or five florets; their florets are longer than their glumes; and they have a pinnatifid or deeply cut leaf attached to the base of each spikelet.

The crested species, *Cynosurus cristatus*, is one of the indigenous, agricultural grasses of Britain. It grows wild both on dry pastures and on wet clayey soils; it makes luxuriant growths on irrigated meadows; and, both as a natural and as a cultivated grass, it is perfectly free from fastidiousness, and possesses a very ample range of adaptation. Its root is fibrous and perennial; its culm is erect, and about 18 or 24 inches high; its leaves are short and somewhat narrow, and taper to a point; the pinnatifid leaves of its spikelets are much longer than the spikelets themselves; and its spikelets are beardless, and, together with their appendages, grow wholly on one side of the panicle. Its culms are not eaten by cattle, and may be seen, on even well-grazed pastures, standing untouched till autumn, and ripening their seeds; but its root-leaves are greedily eaten by cattle, by horses, and particularly by sheep, and are produced in comparative profusion. In the Woburn experiments, on manured brown loam, it yielded, per acre, at the time of flowering, 6,125 lbs. of green produce, and 406 lbs. of nutritive matter. It constitutes a very considerable proportion of the herbage of many of the best sheep pastures, and deserves to be extensively introduced to such sheep-walks as possess either little or none of it; but it ought never to be more than a minor ingredient in cattle pastures. It forms a close sward, and has rather fine herbage; and hence is well suited for bowling-greens and lawns.

The eruca-formed or linear-spiked species, *Cynosurus eruceiformis*,—called by some modern bo-

tanists *Beckmannia erucaeformis*—is a native of continental Europe, and was introduced to Britain about 70 years ago. It is an annual, grows to the height of 2 or 2½ feet, and flowers in July. It thrives best on deep rich loam. An acre of it, in the Woburn experiments, yielded, when in flower, 6,806 lbs. of green produce, and 365 lbs. of nutritive matter.—The blue species, *Cynosurus cæruleus*, now called by some botanists *Sceleria cærulea*, is perennial-rooted, and grows wild in the fields of Britain. It occurs principally on lofty limestone grounds, and seldom has a height of more than 12 or 14 inches. It is an early spring grass, and resists the withering effects of summer droughts; and, on these accounts, it is well fitted for upland sheep pasture.—Several species are now assigned to other genera; and seven or eight known exotic species have not been introduced to Britain.

CYPERUS. A very large genus of herbaceous plants, constituting the type of the natural order Cyperaceæ. This order occupies an intermediate place between the grasses and the rushes, and cannot be more correctly designated by any one popular epithet than sedginess. Some of the cyperaceæ have a rush-like appearance; others are altogether sedges; and others have an intermediate character. All differ from the grasses in the mode of developing their glumaceous flowers, in having the sheath which envelopes the lower part of the leaves closed up, and in possessing comparatively trifling value either as herbage or for economical adaptations. They possess trivial interest to the farmer, only occasional interest to the economist, and no interest whatever to the florist or the landscape gardener. A few are medicinal; two or three are esculent; and some serve for mattings, thatchings, and similar purposes; but the enormous majority are sheer, vile weeds, evoking the enterprise and industry of man for their extirpation, or serving at best to impart a hue of verdure to some barren marshy tracts where no better green thing will grow. About 300 species are either indigenous in Britain, or have been introduced from foreign countries, into our botanical collections, as curiosities; and all these are distributed into 25 genera, the chief or most interesting of which are cyperus, carex, papyrus, and eriophorum.

The genus *Cyperus* has entire-sheathed leaves, two-rowed imbricated spikelets, and a deciduous style. It comprises two indigenous species, about 50 introduced exotic species, and about 250 un-introduced known exotic species.—The long cyperus, *C. longus*, grows wild in the marshes of England, but is not common. Its root is perennial, long, somewhat creeping, and very aromatic and astringent; its stem is green, principally bare, and about 3 feet high; its radical leaves are grass-like, bright green, narrow, and about a foot in length; and its flowers have a brown colour, are produced from among two or three small leaves at the top of the stem, and appear

in July. — The brown species, *C. fuscus*, also inhabits English marshes, but is merely annual. Its root is simply and numerously fibrous; and its stem attains a height of only 6 or 7 inches.

The esculent-rooted species, or rush-nut sedge, *C. esculentus*, is a native of the south of Europe, and was introduced to Britain near the close of the 16th century. Its roots are tuberous and about the size of pease, and, when eaten raw, have a taste somewhat similar to that of filberts, but are somewhat sweeter and more heating; its stems have a height of only 12 or 14 inches; and its spikelets are elongated, pointed, and rather distant. It grows readily on moist, light, rich soils; and is cultivated in the south of Europe for the sake of its tubers, which are eaten both raw and boiled.—Another esculent and tuberous-rooted species, *C. geminatus*, was discovered, in the southern part of continental India, by the late Dr. James Anderson, and was recommended by him to the notice of Europeans as a plant which might probably prove of considerable value. It grows in sandy and somewhat arid situations near the sea; it is the common food of the natives of some parts of the south of India, during seasons of scarcity; and it yields a pleasant and nutritious farina, which makes a pudding of taste and flavour somewhat similar to one made of sago.

The root of the rush-leaved species, *C. juncifolius*, is fibrous, with small bulbous extremities, and is used in the form of decoction, in India, as a gentle diaphoretic and diuretic, and as a remedy for fevers and for tendency to dropsy.—The perennial hairy portion of the lower part of the stem of *C. stoloniferus*, is, in India, dried, and combined with certain oils into a fragrant liniment for the head, or reduced to powder and given internally as a purifier of the blood.—The stems of the mat-rush, *C. textilis*, are a chief material of the common floor-mats of India.—But no one of the four species which we have named as possessing economical value in India, seems to have been introduced to Britain.

CYPRESS,—botanically *Cupressus*. A genus of trees, constituting the type of the suborder Cupressinæ, in the Coniferous order. This suborder comprises the genera cupressus, juniperus, thuja, callitris, and dactrydium; and has at present, within Great Britain, about forty species,—all ligneous evergreens, most of them sombrely ornamental, and a considerable proportion tall, imposing, solemn-looking timber-trees. The genus cupressus comprises twelve known species; three of which have been long cultivated in Great Britain, and five introduced since the commencement of the present century. It belongs to the class Monœcia, and the order Monadelphia of Linnæus. Its male inflorescence is an imbricated catkin, with one-scaled calyx, and four sessile, a filamentous anthers; and its female inflorescence is a subconical catkin, changing to a strobile, with

a one-flowered scale calyx, two concave pointed stigmas, and an angular seed or nut.

The common cypress, *Cupressus sempervirens*, is a native of Candia, Italy, Spain, and Portugal, and was introduced to Britain about the middle of the 16th century. Its leaves are imbricated, much united to the branchlets, somewhat keel-shaped, the older ones sharply-pointed and divergent, and the younger ones flattened and close; and its cones grow on the sides or extremities of the branchlets, are small and orbicular, and have scales which, before being ripe, are thick, green, and fleshy. Three varieties of it, so well defined as to have been frequently regarded as distinct species, have long been in cultivation,—the upright, the spreading, and the small-fruited. The upright variety is a most elegant plant, and deserves far more favour than it has yet received. It usually attains a height of about 20 or 25 feet; it lives to a great age; it grows quite erect; it has an obeliskal or oblongly conical outline, and a dark-green, sombre, and somewhat grotesque foliage; and it is well adapted by its outline for a place near houses, walls, or bridges with pre-eminently horizontal lines, and by its solemn appearance, and dark, evergreen, imbricated foliage for prominent situations in all sorts of burying-grounds. The spreading variety has a more expanded and less regular head than the upright variety; but, though inferior to it for ornamental purposes, is superior for the economical value of its timber. It abounds in the Levant, and is there regarded as both a very common and a very valuable timber-tree. The wood of both varieties is dark or brownish red, possesses an agreeable sweetish fragrance, and makes an exceedingly durable resistance to both the animal and the chemical causes of the usual decay of timber. The small-fruited variety is still more spreading and irregular in its boughs than even the spreading variety. If allowed plenty of room, and not interfered with when growing, it will feather itself with branches and foliage from top to bottom. It attains about the same height as the upright variety, and has a massively and sombrely ornamental appearance, either when growing alone upon a lawn, or when grouped with other trees in a clump.

The thuya-like cypress, arbor-vitæ-like cypress, small blue-berried cypress, American cypress, American white cypress or white cedar, *Cupressus thuyoides*, called by Richard *Thuja sphaeroidea*, is a native of Canada, Maryland, and other parts of North America, and was introduced to Britain in 1736. Its stem grows in its native country to the height of 70 or 80 feet, but usually attains in Britain a height of only about 10 or 15 feet; its branches stand two ways, and are pretty numerous; its head is massive and regular; its leaves, though small, are imbricated like those of the arbor-vitæ, and have a lighter or browner tint of green than those of the common cypress; and its cones are globular, bluish or dark brown,

about a quarter of an inch in diameter, and pretty similar in appearance to the berries or cones of juniper, and are produced in great plenty all over the plant. Most plants of it in Britain are raised from cuttings, and have a strictly shrubby character; but even these are highly ornamental in almost every kind of situation in which they can be grown. Plants raised from cones, and grown in moist soil, attain a comparatively great height, but are exceedingly tardy in growth. Trees of this species, soaring to the altitude of 70 or 80 feet, but rarely having a girth of more than three yards, compose great masses of forest, in the salt-marsh maritime districts of Maryland, Virginia, and New Jersey. The timber is soft, light, and fine-grained, has a rosy tint and a strong aromatic fragrance, and, if properly seasoned and managed, is exceedingly durable. It is used for shingles, for boat-wood, and for almost all the manufacture of the cooperage. So profusely and distinctively is the timber employed in the last of these ways, in Philadelphia, as to have given the name of cedar-coopers to an entire class of mechanics; and all the smaller trees, by having their trunks and chief branches split in two, are used by the farmers in the neighbourhood of the cedar-forests for making exceedingly durable field-fences and rails.

The Portugal cypress or cedar of Goa, or cedar of Busaco, *Cupressus lusitanica*, called by Lamarck *Cupressus glauca*, was introduced to Britain from Goa in the latter part of the 17th century. It possesses a conical outline till it attains its full height; and it then acquires a flattened or spreading top, and has large, spreading, and beautifully pendant branches. Its fronds or branchlets are thin, slender, and divergent; its leaflets are four-rowed and densely imbricated, and have a light green colour; its male flowers are yellow, ovate, terminal, and numerous; and its cones are suborbicular and about one-third of an inch in diameter, and have but few scales, and these thick and recurved. It takes the popular names of Portugal cypress and cedar of Busaco, from the circumstance of its being extensively grown in the vicinity of Busaco in Portugal.—The species of cypress introduced to Britain since the commencement of the present century, are the southern or slender-branched, *C. australis*, a somewhat tender plant, 10 or 12 feet high, from New Holland; the pendulous, *C. pendula*, a very beautiful but rather tender tree, 20 or 25 feet high, from Japan; the twisted, *C. torulosa*, 20 or 25 feet high, from Nepaul; the berry-shaped, *C. bacciformis*, 20 or 25 feet high, from Japan; and the triangular, *C. triquetra*, 12 or 15 feet high, from the Cape of Good Hope.—Two species which were long raised in British nurseries and grown in British shrubberies under the name of cypresses, are now regarded as not properly akin to any of the genera of the cupressinæ, and have been constituted a genus of the suborder taxinæ. See the article SCHUBERTIA.

CYPRIPEDIUM. See LADIES' SLIPPER.

CYRTANTHUS. A genus of beautiful, tuberous-rooted, Cape-of-Good-Hope plants, of the amaryllis order. Their name means "curved flower," and is expressive of their most striking distinguishing feature. Nine or ten species, with stems from 10 to 30 inches high, and with floral colours of different kinds of red from pink to orange, have been introduced to Britain; and may simply be regarded as an allied group to the gorgeous genus of amaryllis proper.

CYSTITIS. See INFLAMMATION.

CYTISUS. A genus of beautifully flowering shrubs and small trees, of the genista division of the pea family. A number of species formerly included in it are now assigned to six other genera; but about fifty known species still belong to it, and about forty of these are cultivated in Great Britain. Most are natives of the middle and southern parts of continental Europe; nearly all are shrubs, and carry yellow-coloured flowers; a considerable proportion are sub-evergreen, and four are almost wholly evergreen; one, the common broom, is abundantly indigenous; and all, with two partial exceptions, are quite hardy, and well fitted to adorn lawns, shrubberies, and gardens. The beautiful and generally diffused laburnum is the type of the whole, but far exceeds them all in size. See the articles BROOM and LABURNUM. Some have their flowers in terminal racemes, and others in axillary or close terminal heads; and the former class greatly excel the latter in beauty. The leaves of all are trifoliate, alternate, and stipulate; their calyxes are two-lipped; and their pods are glandless, compressed, and many-seeded.

The sessile-leaved cytisus, or smooth round-leaved cytisus, or trefoil-tree, or base tree-trefoil, *C. sessilifolius*, is a native of Italy, Spain, and France, and was introduced to Britain in the former half of the 17th century. Its height, in natural growth, is about six feet; its branches

are round, smooth, brown, erect, and very brittle; its leaves are small, smooth, shining, and nearly of a fine green colour, and, on some branches, they are strictly sessile, while on others they have very short footstalks; and its flowers are produced in short, erect, terminal racemes, and have a fine yellow colour, and appear in May and June, and exist and flourish in such profusion as almost to cover the whole shrub with bloom. This species is in very general cultivation in British gardens as a shrub; but in some districts, particularly in the vicinity of London, it is sometimes grafted standard-high on the laburnum, and it then forms a most symmetrical, round-headed, luxuriantly-flowering small tree.

The black cytisus, or blackish smooth cytisus, *C. nigricans*, is a native of Austria, Bohemia, Spain, and Italy, and was introduced to Britain in 1730. Its usual height is from 3 to 6 feet; its outline is bushy; its branches are numerous, and covered with a brown bark; its young shoots are greenish red; its leaves consist of oblong-oval folioles, and are dark green above, and paler below; and its flowers are produced in long, erect, close, terminal racemes, have a beautiful yellow colour, and appear in June and July. The epithet "black," in its popular name, refers to its root.—The purple-flowered species, *C. purpureus*, was introduced from Austria about half a century ago. It grows about 3 or 4 feet high, has a tubular calyx, and blooms from May till August. A variety of it, *C. p. albiflorus*, has white-coloured flowers. The white species, *C. albidus*, is a native of the south of Europe, grows 4 or 5 feet high, carries white flowers, and blooms in June and July. The white-flowered species, *C. leucanthus*, was introduced from Hungary in 1806, and has pale-yellow or yellowish-white flowers. All the other species have yellow flowers; and many of them are so nearly like one another as scarcely if at all to possess any true specific character.

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